Introduction to ArcView GIS

for Conservation Districts & USDA Partners

Kittitas County
Conservation District

Developed by: Nicole McCoy, Kittitas County Conservation District
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WELCOME TO

INTRODUCTION TO ArcView GIS

FOR

CONSERVATION DISTRICTS & PARTNERS

TWO-DAY WORKSHOP

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CLASS OBJECTIVES

◊ Understanding Concepts of GIS

◊ Using ArcView - Basics

◊ Working with Digital Orthophotographs

◊ Creating New Spatial Data

◊ Applying ArcView to
Conservation Planning

Course Syllabus
Introduction to GIS for Conservation Districts Version 2.1

Text and Other Resource Materials:

Introduction to GIS for Conservation Districts, Kittitas County & Thurston Conservation Districts
Using ArcView GIS, Version 3.2a Environmental Systems Research Institute (ESRI)
Getting to Know ArcView GIS. ESRI

Course Objectives:

Upon the completion of this course, the student will:

A. Know how to operate ArcView GIS.
B. Become familiar with image data.
C. Be able to apply ArcView's GIS technology to conservation planning.

Course Content and Schedule:

Content will include lecture, demos, and hands-on training.
Two days (8:30 – 5:00 Day One & 8:00 – 4:00 Day Two)

Day 1:

- Overview of the training program
- GIS Concepts
- Arcview Basics:
  - Projects & Views
  - Themes & Legend Editor
  - Tables & Queries
  - Buffering
  - Labeling, Layouts and Printing
  - Review/Q&A

Day 2:

- Review of Day 1
- Creating New Data
  - Create New Project
  - Create New Theme & Table
  - Digitize and Edit Data
- Conservation District Applications
  - Making Farm Plan
  - Working with Soils Data
  - Working with Data
  - Review
- Final Q&A

Geographic Information Systems
within the
Washington Association of Conservation Districts

Since 1997, GIS development has been ongoing within about 5 conservation districts for less than ten years. However, each district has done GIS independently depending on the interest and technical skills available among staff. Through cooperative efforts by the Kittitas County Conservation District, Thurston Conservation District and the Natural Resources Conservation Service, a Statewide GIS Training Program has been established and is funded by a Washington Conservation Commission (WCC) water quality competitive grant. In 1998, the first phase of the training program was underway. Over half of the CDs participated in GIS and are using it on a regular basis. Due to the success of the program, in 2000 the second phase, also funded by the WCC, has begun. It includes both basic and advanced ArcView training through June 30, 2001.

Vision Statement:

1. To make it economically feasible for all interested conservation districts to be able to utilize ArcView GIS for water quality conservation planning by the end of the grant.
2. To provide the necessary training for all Districts to reach their GIS goals.

Project Goal:

The goal of the Statewide GIS Training Project is to improve analysis of water quality changes resulting from conservation planning and implementation activities in each conservation district using GIS as a measurement tool.

To achieve this goal Kittitas County Conservation District and Thurston Conservation District will:

- Assess individual GIS needs of interested districts
- Provide all interested districts with consistent, high-quality GIS (ArcView) training
- Provide ongoing support to districts to fulfill their GIS needs

For more details on the Vision Statement and Goals, contact Nicole McCoy (nicole-mccoy@wa.nacdnet.org) or Thurston CD (echarlton@thurstoncd.com)

Acknowledgements

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Sharon O'Connor, *GIS Technical Services, Washington Department Of Ecology*, for permitting us to base our manual on the one she developed for DOE. (Most of Section 2 has changed little from the exercises in her manual).

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Washington State Conservation Commission, for funding the Statewide GIS Training Program through a Water Quality Competitive Grant.

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1 Geographic Information System (GIS) Concepts

What is GIS ?

A Geographic Information System (GIS) is a powerful computer system capable of assembling, storing, manipulating, and displaying geographically referenced information (data identified according to their locations). The features are assembled in a layered format to provide visual effects of multiple layers of data in one location (*Figure 1.1*). The total GIS also includes the operating personnel and the data that go into the system, e.g. soils, vegetation, etc. A GIS links these spatial features with database attributes[1]. For example, common soils attributes include soil type, location, k-factor (erosion), slope, and texture.

A digital map provides several advantages over a hard copy (paper) map:

- new layers can be easily added (soils, waterways, farm tracts, etc)
- changes in map size, area shown and map format can be adjusted quickly without sacrificing the original map product
- analysis of one data layer is possible
- identifying specific features or features that meet selected criteria are accomplished simply and easily

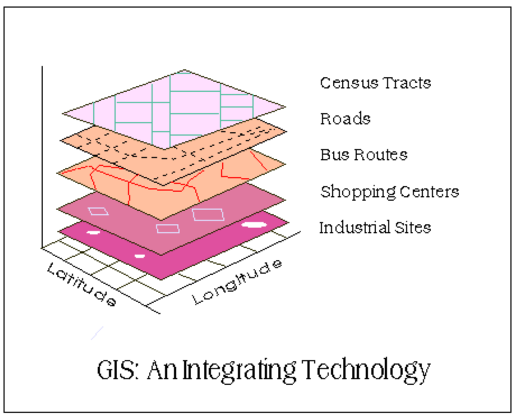


Figure 1.1 Example of how GIS integrates multiple features into one map.

GIS Related Software

<u>Computer Aided Design (CAD):</u>

CAD is popular among architects, engineers and draftsmen for creating digital blue prints and drawings in 3-D if desired. Data is organized by layers and not topological structures as GIS is. Many CAD software packages emphasize three-dimensional capabilities and shading. State of

[1] GIS refers to characteristics of features in a database as "attributes." The attributes are linked to the maps for visual processing.

the art CAD software includes AutoDesk's AutoCAD and Intergraph's Microstation. ArcView can read AutoCAD and Microstation CAD drawings in their native forms.

Image Processing (IP):

IP software is pixel based and has many capabililties for analyzing images such as remotely sensed imagery. IP software is often used as a backdrop for GIS. ERDAS IMAGINE and Clark University's IDRISI are leading packages in this field.

Geographic Information Systems (GIS):

Maps depict a representative scale of features on the earth's surface. Maps include a north arrow, bar scale, legend and title. Maps are produced from 'layers'. Layers are part of the digital map features made up of points, lines, and polygons in a GIS. GIS can be subdivided into two major types; raster and vector.

- **Raster** packages such as Geographic Resources Analysis Support System (GRASS) are pixel based (grids of cells) which represent areas of interest. Individual cells are identified by the row and column which they occupy. If you 'layer' multiple features in a GIS you could use the "pin method" (F*igure 1.2*), where the location the pin goes through the top layer is the same for the other layers. Raster systems are good for area surface modeling and viewshed analysis. Raster data formats are used in satellite imagery and raster based GIS packages such as GRASS, UNIX Arc/Info Grid, and Spatial Analyst (extension of ArcView 3.0/3.1).

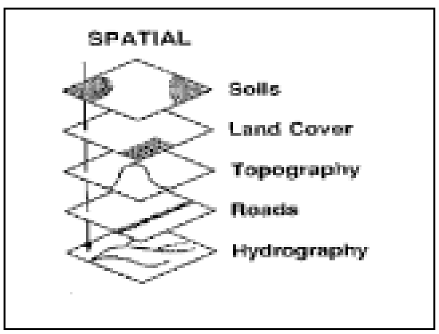


Figure 1.2 Pinpoint of a location

- **Vector** data also represents features as points, lines, and polygons. A point is an X and Y coordinate, a line is a string of consecutive points, and a polygon is a string of consecutive points that closes back upon itself. Vector data sets can have topology, which means that in addition to maintaining the position of every feature, the software maintains the spatial relationships of adjacency and connectivity between features (i.e. it 'knows' where all features are and how they relate to each other). The most common software of this type is ARC/INFO and ArcView. Many GIS packages are bridging the gap between raster and vector data and accept both. Arc/Info and GRASS can work with both types of GIS. ArcView can also work with both raster and vector data with the addition of the Spatial Analyst extension (extensions are ArcView's optional add-on programs designed to expand its functionality).

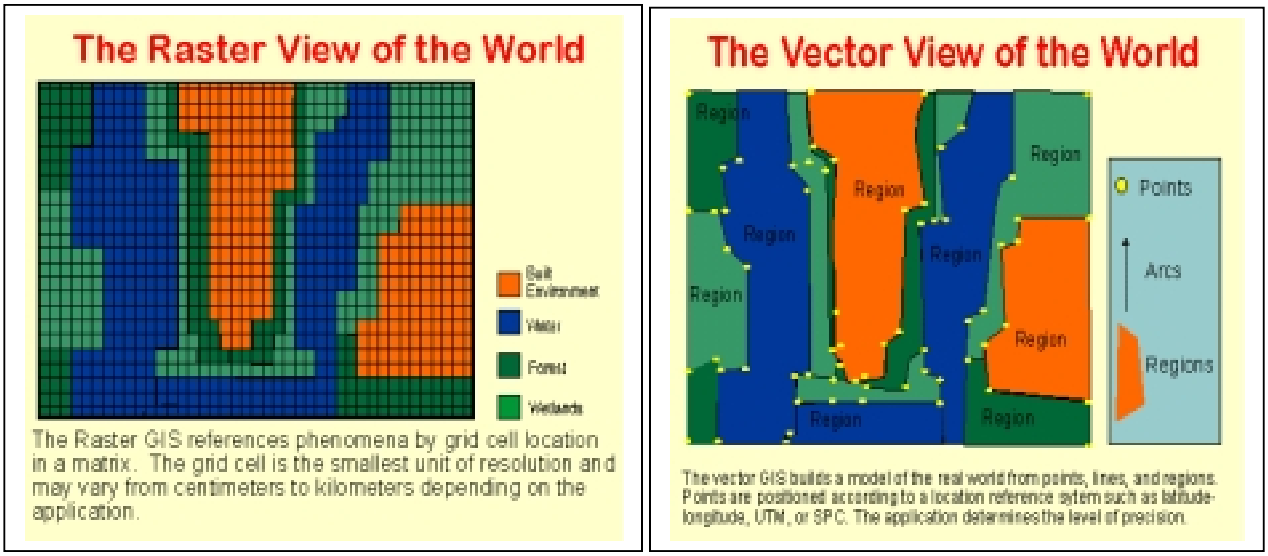


Figure 1.3 Comparison of raster and vector formats.

RASTER

<u>ADVANTAGES</u>	<u>DISADVANTAGES</u>
• Simple data structure	• Usually greater storage space on computer
• Compatible with remotely sensed or scanned data	• Depending on pixel size, graphical output may be less pleasing
• Simple spacial analysis programs	• Projection transformations are more difficult
• Can handle complex analytical modeling	• More difficult to represent topological relationships

VECTOR

<u>ADVANTAGES</u>	<u>DISADVANTAGES</u>
• Requires less disk storage space	• More complex data structure
• Topological relationships are readily maintained	• Not as compatible with remotely sensed data
• Graphical output more closely resembles hand-drawn maps	• Software and hardware are often more expensive
	• Some spatial analysis procedures

may be more difficult

Desktop GIS - ArcView:

Desktop GIS was designed to get GIS into the hands of decision makers and non-technical people by providing more user friendly programs based on point and click navigation and an easy-to-follow graphic user interface (GUI) on a PC. ESRI, the producer of full-fledged GIS packages, e.g. ARC/INFO, developed ArcView to perform most of the tasks of ARC/INFO. ArcView is limited in data management analysis and customization capabilities compared to ARC/INFO. However, it serves the needs of conservation districts in producing high quality maps that reflect spatial relationships, patterns and trends. ESRI continues to provide more and better capabilities for ArcView users. It is quickly becoming the most widely used desktop GIS in the world.

Note: ArcView is the GIS that's most compatible for Districts, NRCS and Service Centers.

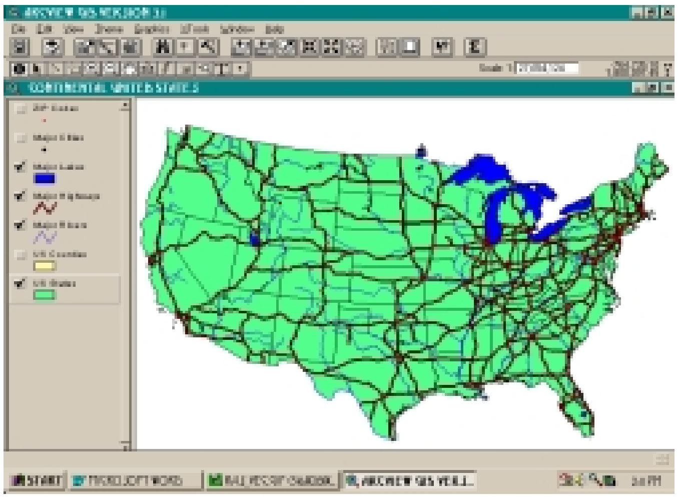


Figure 1.4 A "View" in ArcView desktop software.

Understanding Geographic Data

From geographic data we can get valuable information for conservation planning. There are three basic forms of data used in GIS: spatial, tabular, and image data.

Spatial Data is data that encompasses space. It contains the locations (e.g. Latitude-Longitude) and shapes of map features that include points, lines and polyons. Addresses are referred to as spatial data because their physical characteristics include location and position. Other examples of spatial data include roads/rivers (line), soils/municipal boundaries (polygon), shopping centers/wells (point) and image data (see "GIS Data Types: Geospatial Data", pg. 1-18).

Tabular data is descriptive data in a database format that GIS links to map features. It can be spatial as well, (e.g. addresses, bird sites), but it doesn't have to have geographic coordinates to be used in GIS. For example, you can link census data to county boundary data and see demographic statistics per area in the county.

Image data includes aerial photographs, satellite imagery, and scanned data (topographic maps, photos of houses, etc.). You can store scanned images as attributes in a GIS database.

GIS Data Types

- **Map Features**

There are three major types of vector data in ArcView

Point: soil sample sites, wellheads, monitoring sites, etc.
This is the easiest type of spatial information to collect and store. Point data can be listed in a database; with the x and y coordinates stored in the table or it can be "linked" to spatial data. The most accurate point source data is recorded with a GPS.

Line: (roads, utility lines, streams)
A series of points strung along a line. The lines are linked together as a discrete unit. There is no enclosed area.

Polygon: (lakes, land use, field boundaries)
Polygons consist of a series of points located along a line that is enclosed and the enclosed area is labeled as a discrete unit. GIS applications know what locations are within the enclosed area and which are outside.

- **Geospatial Data**

Digital Orthophotography : A digital orthophoto is a digital image of an aerial photograph in which distortion caused by the camera tilt and terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. It is crutial to use orthophotgraphy when measuring area and distance.

Origin

- USGS: Digital Ortho Quad (DOQ) black and white or color infrared, 1meter ground resolution, UTM
  coordinate system, NAD 83, quarter-quad image covering 3.75 minutes of latitude and 3.75 minutes of longitude, at scale of 1:12,000

- DNR: tiled by township and range, black and white, 1 meter ground resolution, State Plane coordinate system, at scale of 1:24,000.

NRCS is providing DOQs (if available) for NRCS and Conservation Districts

Digital Raster Graphics (DRGs): A digital raster graphic is a scanned image of a USGS standard series topographic map (7.5-minute quad), including all map collar information. The image inside the map neatline is georeferenced to the surface of the earth and fit to the UTM projection. The horizontal positional accuracy and datum of the DRG matches the accuracy and datum of the source map. The map is scanned at a minimum resolution of 250 dots per inch.

A DRG can be used on-screen to collect, view, and revise other digital data, especially digital line graphs (DLGs). When the DRG is combined with other digital products, such as DOQs or Digital Elevation Models (DEM), the resulting image provides additional visual information for the extraction and revision of base cartographic information.

NRCS is providing USGS DRGs for NRCS Conservation Districts in UTM, scale 1:24,000, 1:100,000 and 1:250,000

Digital Line Graphics (DLGs): Digital Line Graph data are digital representations of cartographic information. DLGs of map features are digital vectors converted from maps and related sources. USGS DLG data are classified as large, intermediate, and small scale.

Digital Elevation Model (DEM): A DEM consists of an array of regularly spaced elevations. The DEMs available from USGS are in 7.5-minute, and 1 degree units.

A DEM file is organized into three logical record types: A, B, and C. The type A record contains information defining the general characteristics of the DEM, including its name, boundaries, units of measurement, minimum and maximum elevations, number of type B records and projection parameters. There is only one type A record per DEM file. The type B record contains profiles of elevation data and associate header information. There is a type B record for each profile. The type C record contains statistics on the accuracy of the data.

(Must have Spatial Analyst to view DEMs)

ArcView Supported Data Types

Data in many formats can be added to a View (map) as a Theme (layer), including data on your computer's own disks, on CD-ROM, across the network through LAN/WAN, and through internet (web sites: USGS, DOT, ESRI, etc.) ArcView supported data types include:

- Shapefiles
- ARC/INFO Coverages, (including .e00 export files)
- SDE layers
- Image formats
- CAD drawings
- Tabular Data (Info, d-BASE, SQL. Sybase)

Data Acquisition Techniques (Geocoding)

Geocoding is the conversion of spatial information into digital form. There are various methods for acquiring data. Attribute data is accessible through a database file such as in dBase format in Excel, or Microsoft Access format. Spatial data can be accessed by the following geocoding methods:

Digitizing:

Digitizing is the process of tracing paper maps and converting the drawing to a digital format. It can be done with a digitizing tablet (table and puck) or on-screen (a mouse and the computer monitor)[2] . The data being digitized will be in the same coordinate system as the digital ortho photos *(see Section 3: Creating Spatial Data).*

Scanning:

Scanning will convert hard copy products to a computerized raster (pixel) representation. Scanning can be done at various resolutions (smaller resolution equals larger file size and clearer images). Scanned data can be vectorized using Arc/Info and other software packages. Keep in mind that if aerial photographs have not been rectified (geographically corrected for displacement), then they are not orthophotos; the image data will not be to scale and will contain distortion errors.

Global Positioning System (GPS):

GPS is comprised of a series of about 20 Department of Defense satellites that orbit the earth. These satellites send locational information back to earth. Commercially available receivers can capture that data (from a minimum of three satellites at any given time) to give the GPS receiver operator a coordinate location accuracy. General measurements can be obtained immediately and processed in a computer to obtain a very accurate measurement; within sub-meter, depending on capability of the receiver. *(Figure 1.5).*

Remote Sensing:

Cameras, balloons, satellites, and any other remote object collects information in the electro-magnetic spectrum (e.g. infrared, visible, radar, etc.). Images from remote sensing are in raster format.

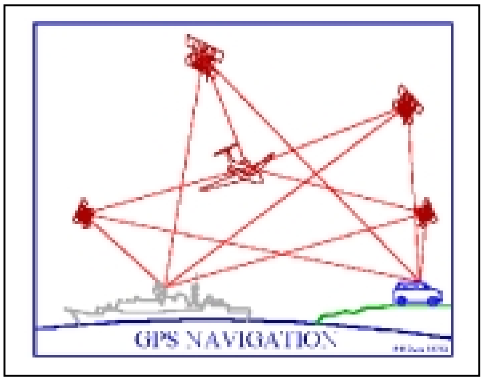


Figure 1.5

[2] This course focuses on digitizing on-screen, using digital ortho photography as base maps.

Map Scale and Map Accuracy

Map scale is the relationship between the dimensions of a map and the dimensions of the Earth. It is usually expressed as a ratio between a distance on the map and a distance on the Earth, like 1:63,360. The scale ratio 1:63,360 means that one unit of distance on the map represents 63,360 of the same units of distance on the Earth. So on a 1:63,360 scale map, one inch on the map equals one mile on the ground (one statute mile has 63,360 inches).

Because the scale ratio is a constant, it is true for whatever units in which the fraction is expressed. So on a map with a scale of 1:24,000, one centimeter equals 24,000 centimeters on the ground, just as one inch represents 24,000 inches.

- ### Large and Small Scale Maps

A large scale map shows a small area of the Earth, usually in detail. It is a 'zoomed-in' version of a map. Large scale maps are typically used to show site plans, local areas, neighborhoods, towns and cities. 1:2,500 is an example of a large scale. [Remember, large scale – details are large.]

A small scale map shows an expansive area of the Earth. Small scale maps generally show less detail than large scale maps, but cover large parts of the Earth. Maps with regional, national, and international extents typically have small scales, such as 1:1,000,000. [Remember, small scale, details are small.]

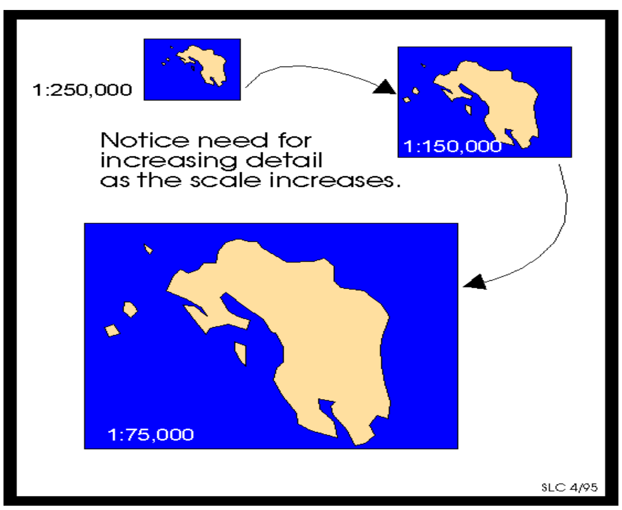


Figure 1.6 Example of differences in small scale (top) and large scale (bottom) maps.

When you zoom in on a View (map), the scale of the View gets larger, and when you zoom out the scale gets smaller. Note that the larger a scale is the smaller will be the number in the scale. For example, a 1:12,000-scale map is said to have a larger scale than a 1:24,000 scale map.

> **Note:** Remember that, as scales become smaller, one unit of map distance represents a larger distance on the ground. So if one of the features shown on a very small scale map is out of line a little, it represents a substantial inaccuracy in reality.

- **Map Detail**

It is natural to equate detail with accuracy. However, when we talk about the level of detail on a map, we are referring to the quantity of geographic information shown. Map accuracy, on the other hand, is a statement of the quality of this information.

While large scale maps typically show more detail than small scale maps, there is no standard rule for how many features a map of a given scale can show, and in how much detail. Instead, this is a cartographic decision depending on the purpose of the map and how many symbols can be drawn in the available space without visual clutter.

On smaller scale maps there is simply not enough room to show all the available detail, so features such as streams and roads often have to be represented as single lines, and area features like cities, have to be shown as points. This is called generalization.

When features are generalized their level of detail is reduced to avoid cluttering the map, but their overall shape and position is retained. Hence, a small scale map of a coastline won't show every cove that you might see on a large scale map. Smaller scale maps may also omit features completely. Spatial data is usually already generalized. For example, a 1:250,000 map of the state contains less detail (and is a much smaller dataset) than a 1:12,000 Section, Township, Range map.

- **Map Accuracy**

The accuracy of a map is not dependent on the map's scale. Instead, it depends on the accuracy of the original data used to compile the map, how accurately this source data has been transferred onto the map, and the resolution at which the map is printed or displayed.

The accuracy of the maps you create depends primarily on the quality of the coordinate data in your spatial database. To create the spatial data, existing maps or manuscripts may have been digitized or scanned, and other original data, such as survey reports, aerial photographs and images, and data from third parties may also have been used. Your final map will therefore reflect the accuracy of these original sources.

> **Note:** It is always important to consider map accuracy to ensure that your data is used appropriately. Don't base important decisions on geographic data that you don't know the source and accuracy of. (See Managing Error, Appendix 2).

- **Spatial Accuracy**

All maps lie. No map is perfectly accurate. No data on any map is exactly where it is shown. Depending on the scale that information was collected and mapped at, its spatial accuracy will vary. Therefore, depending on the map, each feature could be within a certain distance of where it actually is. There are national map accuracy standards requiring that features be within set tolerances. A map that meets national map accuracy standards will state that in the legend.

> NRCS Soil survey data meets USGS Soil Survey Geographic (SSURGO) standards of + or - 20 feet.

Spatial accuracy is doubly important when data is computerized (i.e. scanned or digitized). This is because another level or error is built into the digital version when someone imports the data. For example, people often want to digitize hand drawn field information from a 1:24,000 topographic map (USGS quad sheet). Often the map has been folded, the lines drawn with a thick pen and the 'artwork' may not be very precise.

- **Map Resolution**

The resolution of a map determines how accurately features on the map can be depicted for a given scale. Resolution depends on the physical characteristics of the map, how it was made, what kinds of symbols are used, and how it is printed or displayed on-screen.

For example, imagine you are making a map showing property boundaries at a scale of 1:63,360 using a line symbol that prints out to be 1/100 of an inch wide. This width of this line symbol represents a corridor on the Earth that is almost 53 feet wide! The resolution of that line symbol on a map that scale clearly has some impact on the map's level of detail and accuracy.

Similarly, the resolution of the computer screen you are using has an impact on the detail and accuracy of maps that you draw on that screen. The screen uses pixels to draw your map, and can't draw features or parts of features that are less than a pixel wide.

> **Note**: When using data created by others, note the scale the data is based on (or created from), the date it was created, and the purpose for its creation. This will indicate if this data is appropriate for your needs.

A map based on highly accurate spatial data will lose accuracy if printed or viewed on a low-resolution device. Remember that the resolution of printers and plotters are generally higher than that of computer screens.

Coordinate Systems

Coordinate systems are made up of spheroids, datums and projections, and are in specific units of measure (e.g. feet, meters, etc.). Locations on the globe are measured in degrees of latitude and longitude. Locations on a map are measured using X and Y coordinates. The most commonly used coordinate systems are listed and described below.

- **Spheroids**

A spheroid is a mathematical description of the earth. Over time, these mathematical expressions have changed from describing the earth as a perfect circle to calling it a spheroid (i.e. an egg shape). For years the US standard was the Clarke 1866 but improvements in measurement techniques have moved the standard to GRS80.

- **Datums**

A datum is a set of control points whose geometric relationships are known either through measurement or calculation, and is used to define a coordinate system. Its base, or reference, elevation is used as the origin to define subsequent elevation. Datums are based on a particular spheroid. There are two datums used almost exclusively in the US, the North American Datum of 1927 (NAD27 is based on Clarke 1866), and the North American Datum of 1983 (NAD83 is based on GRS80[3]). Converting digital data based on the NAD27 to NAD83 can cause features to migrate slightly. New USGS 7.5 minute topographic maps show the corners of the map in both datums.

- **Projections**

Projection is the process of representing a three-dimensional surface (sphere) into a two-dimensional surface (plane) using mathematical expressions. This process distorts at least one of these properties: **shape, area, distance, and direction.**

The most popular projections in the U.S. are the following:

1. Conic: A cone is placed over the globe touching one or two standard parallels and information is transferred onto the cone. The most popular conic projections: Equidistant Conic, Lambert's Conic Conformal and Alber's Equal-Area Conic *(Figure 1.7).*

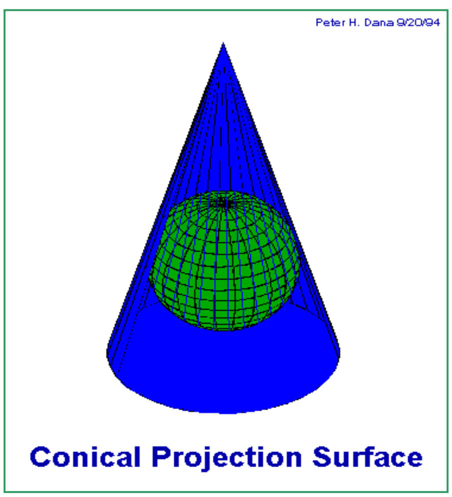


Figure 1.7

[3] Geodetic Reference System (GRS80) elevation measurements were taken in 1980.

- **State Plane Coordinate System**

This is a system that divides all fifty of the United States, Puerto Rico and the US Virgin Islands into over 120 numbered sections, referred to as zones. Depending on its size, each state is represented by anywhere from one to ten zones. Each zone has an assigned USGS code number, each having a designated central origin which is specified in degrees. In Washington, the state is divided into the north and south zones, with the division at parallel 47° 30' north latitude. Washington uses Lamberts Conic Conformal projection with the State Plane Coordinates – South Zone, NAD 27 *(Figure 1.8)*.

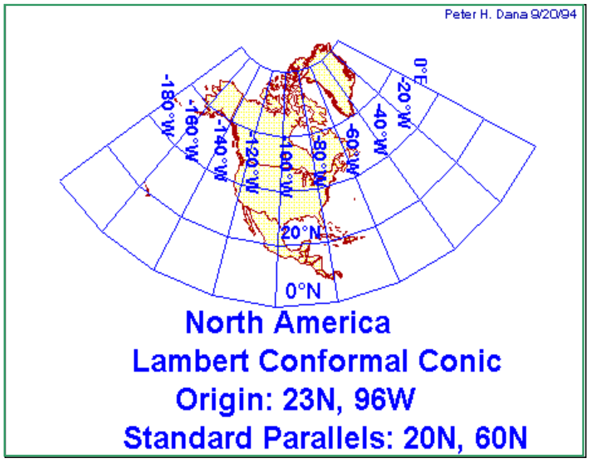


Figure1.8 Polyconic Projection (State Plane)

<u>2. Cylindrical</u>: A cylinder is placed over the globe touching one or two standard parallels and information is transferred onto the cylinder. The Mercator projection is the most popular of this type *(Figure 1.9).*

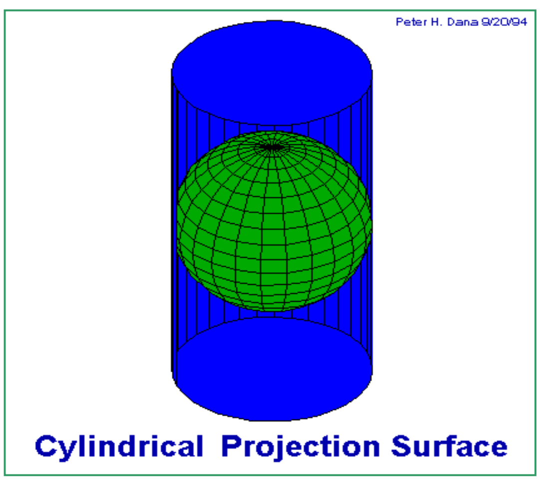


Figure 1.9

- **UTM (Universal Transverse Mercator)**

For the Universal Transverse Mercator System, the globe is divided into sixty zones, each spanning six degrees of longitude. Each zone has its own central meridian. The limits of each zone are 84°N, 800°S.

Each UTM zone has its own central meridian from which it spans 3 degrees west and 3 degrees east of that central meridian. X- and y-coordinates are recorded in meters. The origin for each zone is the Equator and its central meridian *(Figure 1.10)*. To eliminate negative coordinates, the projection alters the coordinate values at the origin. The value given to the central meridian is the false easting, and the value assigned to the Equator is the false northing. For locations in the Northern Hemisphere, the origin is assigned a false easting of 500,000, and a false northing of 0.

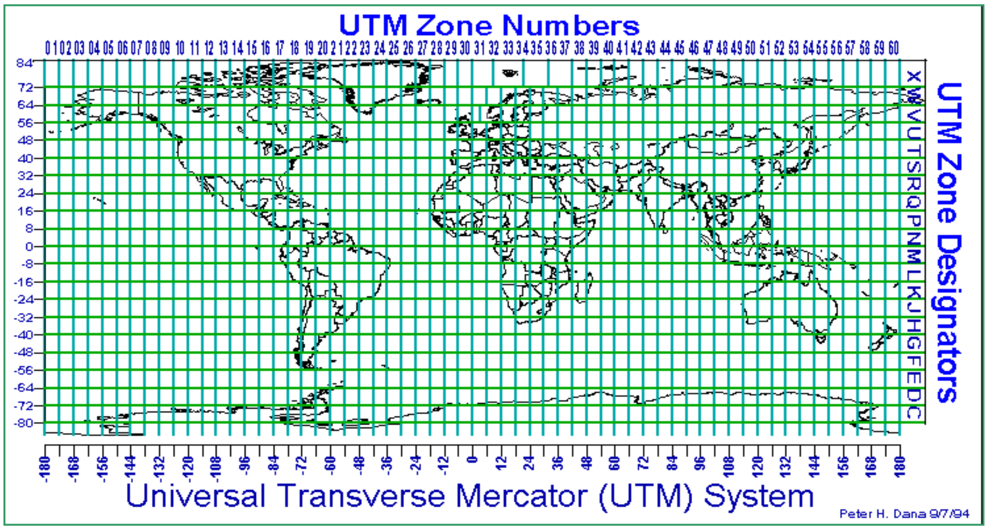


Figure 1.10

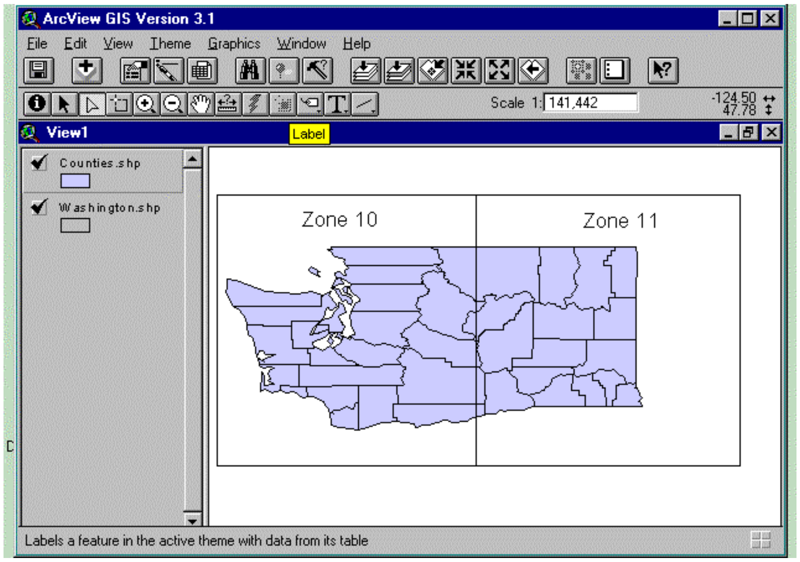


Figure 1.11 UTM Zones in Washington (not exact).

- **Latitude and Longitude**

Latitude and Longitude is not a two-dimensional coordinate system but is commonly referred to as one. Lines of latitude run parallel to the equator. Longitude lines run north-south and converge at the poles. Therefore, the length of one degree of longitude varies depending on the latitude at which it is measured. For example, one degree of longitude at the equator is 111 kilometers in length, but changes to zero at the poles. Latitude and longitude are measured in degrees, minutes, seconds and therefore aren't associated with a standard length. They therefore cannot be used as an accurate measure of the distance or area. A common latitude and longitude of Washington is 48 degrees north latitude and 122 degrees west longitude.

You don't have to have data projected to see it in a GIS. In ArcView, if the data source units are in "decimal degrees" (degrees of longitude-latitude expressed as a decimal rather than in degrees, minutes and seconds), the features can be drawn in any projection. However, if one feature is in decimal degrees and another feature is in another set projection, the two will not be aligned in the same location.

You need data projected when:

- measurements of features are critical
- comparing shape, area, distance, and direction of features
- using image data as a base map to align other features.

Important implications of map projections: (*see Figure 1.12*)

- The larger the area involved, the more important the mapping errors become.
- Projection should meet criterion of the application (area, distance, direction, shape).
- When overlaying data layers, the projections must match.

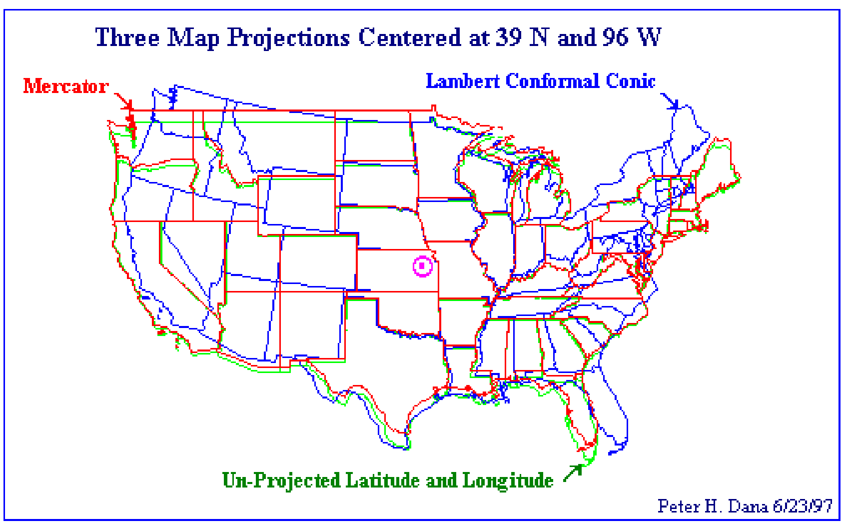


Figure 1.12

2.1 Arc View Basics

Arc View is desktop mapping software (as defined in Section 1 "GIS Concepts") with a user-friendly point and click interface that anyone can use. It is comprised of a **Project, Views, Tables, Layouts, Charts,** and **Scripts**. (Scripts won't be covered in this manual.) For more information on Scripts go to the Help menu in Arc View.

What is a Project?

A Project is the file in which work you do in Arc View is stored. A Project typically contains all the Views, Tables, and Layouts that you use for a particular Arc View application. These are the "components" of a Project which contain "documents" (to be explained later). For example, when you are using Arc View to find locations of soil types for your tasks at hand, you would keep all the Views, Tables and Layouts that you use in this application in one Project. In this way, your work is stored in one convenient place. The next time you want to work on this application you simply open this project file in Arc View and all the components you need are available for you to use. Project files have an .apr extension.

Does a Project contain my data?

A Project file doesn't contain the actual data that you use in Arc View, such as spatial data like shapefiles and ARC/INFO coverages, and tabular data like dBASE files. Instead, a Project stores references to the location of these data sources on disk. In this way, the same data can be used in any number of Projects without duplication. Typically the .apr will be less than 100 KB. Don't let it get to 1 MB or you may have unrecoverable Project failure.

The Project Window

When you open a Project, all the components (**Views, Tables,** and **Layouts)** in the Project are listed to the left in the "Project" window. From the Project window, you can create new Project components, open or rename existing components, or remove components from your Project. When the Project window is active, menu options and buttons are available that let you perform additional operations on the Project and its components.

Exercise 1 Working with Projects

Note: We will be using ESRI's data for all of the exercises in Section 2.

<u>1. Open a new Project in Arc View and save it.</u>

Rule of Thumb: Save, save, save!

It is important to save the Project immediately to limit the possibility of losing data and settings. You will make a new Project and save it even though you haven't done anything so you can see the process of saving.

A. In the Start Menu, go to *Programs\ESRI\Arc View 3.2\Arc View 3.2* (You can also start Arc View from the Desktop).

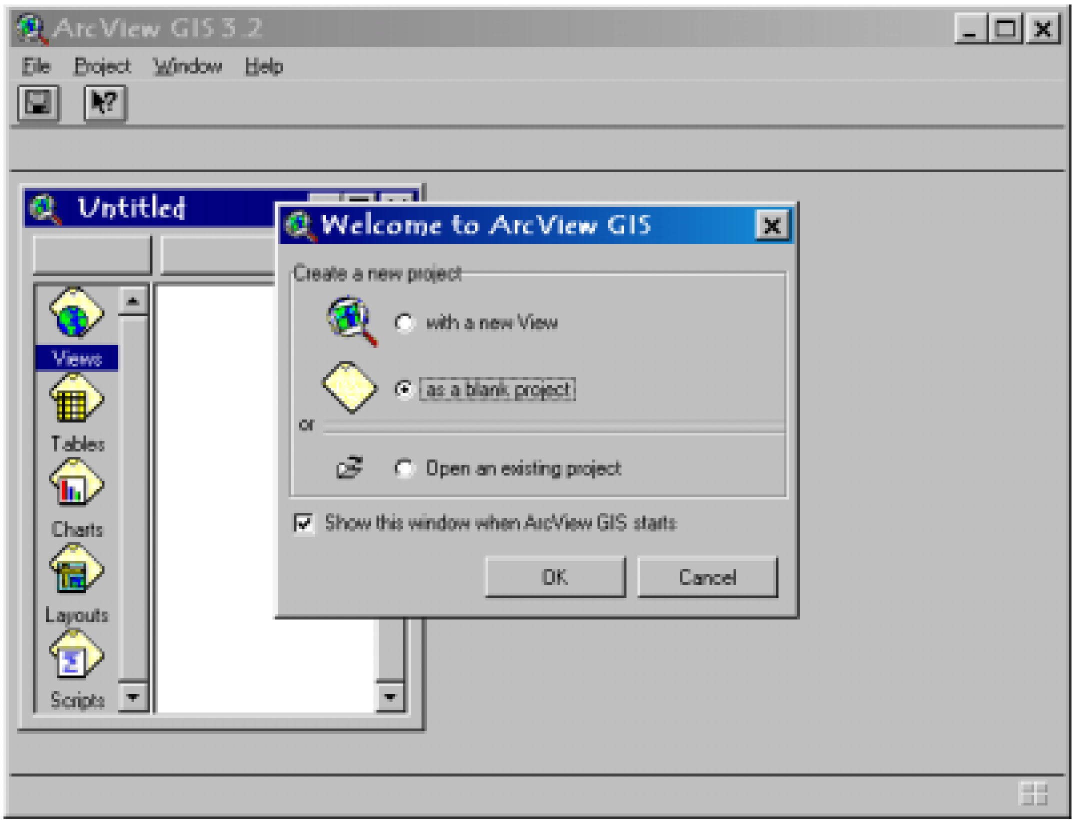


Figure 2.1

B. The "Welcome to ...." dialog box will appear with 3 choices as shown in *Figure 2.1*. Click "as a blank project" and click "OK". A blank Project window with the name "Untitled" will be opened. Maximize the Arc View window and Project window by clicking the "Maximize" buttons in the upper right corner.

C. Look at the graphical user interface (GUI) of menus and buttons. The icons on the left are components of Arc View. Because this is a new "blank" Project there aren't any documents listed..

D. Save the Project: Go to **File** menu and click **Save As**. Name the Project "Proj2" (it will put it in the default directory: *C:\temp*. Now go to **File** menu and click **Close Project**. At this point you will still be in Arc View.

Note: Remember to periodically save your Project. Arc View won't ask you to. It's up to YOU! A quick way to save the Project is "Ctrl S" on your keyboard.

2. Open an existing Project.

A. Go to **File** menu and click **Open Project**. Go to the following directory: *C:\esri\av_gis30\avtutor\Arc View* and click "qstart.apr" under the file name as shown in *Figure 2.2*.

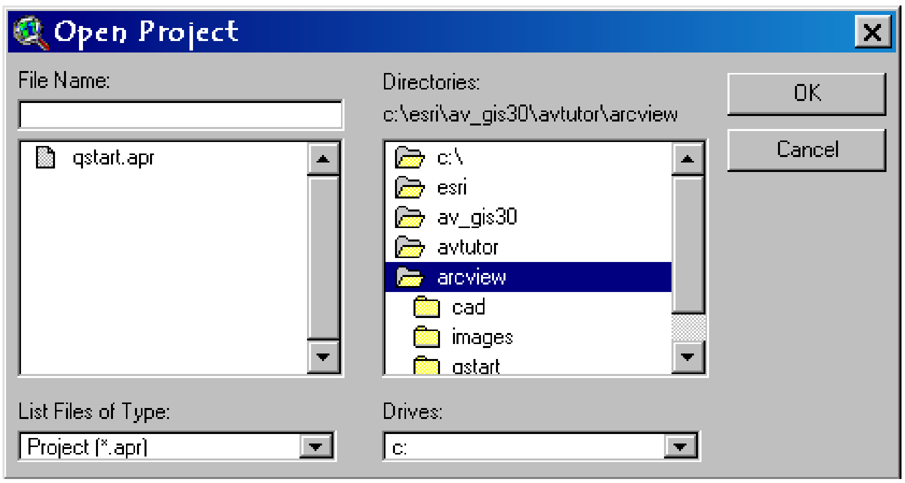


Figure 2.2

The following Project will open with 3 Views listed *(Figure 2.3)*

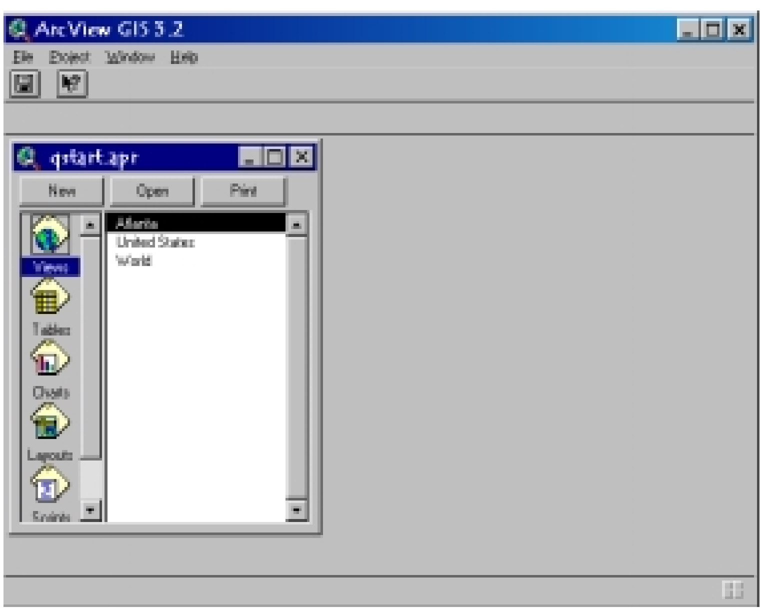


Figure 2.3

3. Open the View document "United States".

Highlight it by clicking the name. Once selected, double click or click **Open** button to bring it into a View. Use which method you prefer.

Note that each Project may contain multiple Views, Layouts, Chart, etc.

4. Move from one component to another.

There are two ways to do this:

1. Close the window by clicking the **X** in the lower box (the X in the far top right will close Arc View)
2. Go to Window menu , and select the Project file name, ie., "qstart.apr" . (*Figure 2.4*). This will activate that window. This applies to all component windows in Arc View. This method works well if you want to keep components open.

> **Note:** Any opened components will be listed in the *Window* menu. You can have many components opened at one time. **Caution!** Before exiting Arc View, remember to save your Project, then select *Close All* in Arc View's *File* menu. You can exit out of the program with multiple components open, but too many could cause the program to crash.

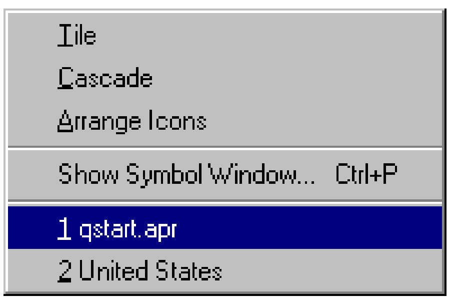


Figure 2.4 Window menu

5. Keep this Project and View open for Exercise 2.

Working in Arc View Components

- **Views**

With Arc View you work with geographic data in interactive maps called Views. A View defines the geographic data you are using and how to display it. Every View has a Table of Contents (Legend). In a View you can display, explore, query, classify and analyze geographic data. Views contain references to the location of the data being used and instructions on its display. They do not contain the actual data. Thus Views are dynamic. If the underlying data for your Project is updated, the View(s) will be automatically updated also. Views can share the same data and different users can create different Views with the same data.

Arc View's GUI (Graphical User Interface):

Commonly know as the Menu Bar, this series of tools and menu items changes with each component type. (see Appendix). In *Figure 2.5*, the GUI for a View is displayed.

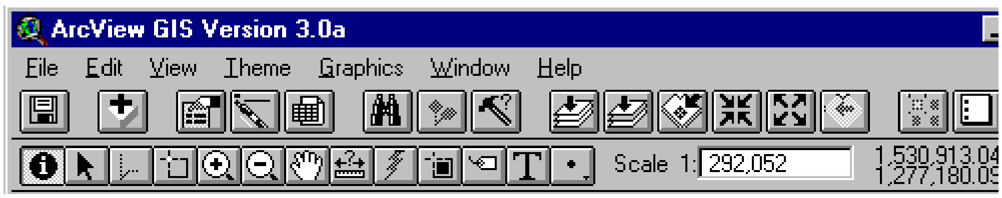


Figure 2.5

The three lines of menus and buttons and tools reflect the controls available in each component.

Starting at the top bar - in general:

1. **Menu Bar** – (the words such as File, Edit, etc,) provides command choices in pull down menus.

2. **Button Bar** – shortcuts for quickly accessing commonly used commands. Actions occur on the View (change of scale, open dialog boxes, go to another View, select or de-select features) by clicking on these buttons.

3. **Tool Bar** – icons that represent tools to modify the action of the cursor in the window. Once the tool is clicked, click on the View for an action to occur.

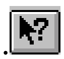
4. **Status Bar** – (<u>at bottom of window</u>) displays brief description of operation that will be performed by that Menu, Button or Tool Bar.

Arc View Help

Utilize Arc View Help as much as possible. It contains a list of Contents, an Index, a Glossary, and an explanation of how to use “Help”.

(You won’t go through all of these steps, but take the time to browse this because it’s user-friendly and helpful).

To find out what a button, tool, or menu choice does:

1. Move the cursor over it but do not select it. A short description will appear in the status bar.
2. Click the Help button . and click on menu items, etc for a detailed explanation.
3. Look it up under the **Help** menu.

To get help about a dialog box:

Press the F1 key on your keyboard when the dialog box is displayed.

There are 3 different way to acquire information through **Help menu, Help Topics:**

1. Contents tab
2. Index tab (mainly used for programming)
3. Find tab (will have to create a glossary in a quick wizard first)

EXERCISE 2 Getting Familiar with Arc View

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1. In the existing View of the “United States”, practice using the Help features to become familiar with some of Arc View’s menus, buttons, and tools.

A. Highlight some buttons and tools to see a discription in the status bar. If you can’t see the status bar, maximize the View window (bottom blue bar).
B. Click the Help button  and click some menu items for a description.
C. Go to **Help menu –Help Topics** and try using the **Content**, and **Find** (Index is mainly used for programming).

2. Changing the display of Themes within the Table of Contents.

(Themes will be covered in more detail in the next section).
The “Table of Contents” (TOC) is the vertical area to the left of the View window which shows all files (Themes) which are open in the View. Here you can change how your Themes are displayed.

You can turn Themes on and off by clicking the check mark to the left of the Theme name.

You can move Themes in the order of the TOC. The Themes are displayed from the "top layer" to the "bottom layer". Typically you want points, lines and polygon outlines toward the top of the TOC. Image files and filled polygons would be toward the bottom. Ultimately the image file has to be on the bottom.

Rule of thumb: points and lines before solids

To move a Theme, click on it. A "raised" rectangle will appear *(Figure 2.6*). This means the Theme is "active". In this case "Highways" is the active Theme. Now you can move it. It is very important to understand what it means when Themes are "active". When they are "active" or selected, you can change their properties, color, query the Theme, look at the Table, etc.. If you think the Theme you want is active and another one is actually selected, the change or information will happen to the selected or wrong Theme. This is a common mistake made by all levels of users.

Figure 2.6

A. Move the Theme "Highways" to the bottom of the Table of Contents by clicking on it and, holding the mouse button down, dragging it to the bottom of the Table of Contents. Note that you can no longer see it as it has been placed beneath the other Themes, even though it is turned on. This is why it is important to have Themes in the correct order to display your features.

B. Practice making Themes active, turning them on and off and moving them to different locations in the TOC. Read the section below titled "Note" and try some of these maneuvers.

Note:

- *On* means the Theme is displayed in the View. (A check mark will be displayed).
- *Active* means the Theme is ready for operations and Table display (it's "raised".
- More than one Theme may be active at a time. To do this hold down the *shift* key while clicking on each Theme you wish to make active. (You can only edit one Theme at a time).
- To turn off all Themes simultaneously go to **View-Themes Off**
- To stop Themes from drawing click the ESC – Escape key. This is beneficial if a Theme like Soils is taking a long time to refresh and you don't need it.

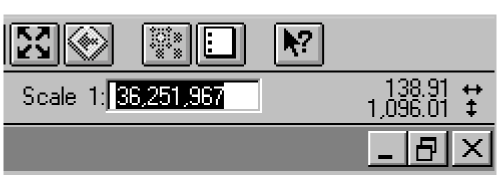
3. Move around in the View using the zoom tools.

Click the zoom buttons and tools below to see how they function. Notice that the scale changes when you do everything by "pan".

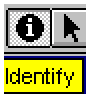
Pan – slides the View to a new location at the same scale (click and drag).
Zoom in with the magnifying glass – click on area to enlarge or click and drag a box around the area (this is the fastest way to zoom into an area).
Zoom out with the magnifying glass – click on area to reduce the size, or click and drag a box around the area.
Zoom to Full Extent of all Themes in the View.
Zoom to Extent of Active Theme (the Theme(s) that have a raised box around their name).
Zoom to Selected Feature - once features are selected, zoom into the area.
Arrows to *Zoom in.* (can click button multiple times to zoom in quickly)
Arrows to *Zoom out* (can click button multiple times to zoom out quickly)
Zoom to Previous Extent zooms to scale the View was at before. (it will go back 5 times)

4. Specify a certain scale.

Highlight the existing scale value and then type in 1,000,000. (Since this scale is extremely small the numbers are very big). (See Section 1 pg. 9)



5. Using the Identify tool.



Click the "i" tool when you want to get quick information associated with a feature.

To identify a feature, it must be selected or active first. Make "US States" the active Theme. Click the "Identify" tool, then click on a State. A dialog box will pop up with all of the data in the database (*Figure 2.7*). You can continue identifying features until you close the dialog box.

Figure 2.7

Note: When you use the "tools" they are active until you click another tool. Click the "Pointer" tool  to keep from continuing an action.

6. Close the Project and don't save changes.

A. In the View window, go to **File** menu, click **Close All**. This will close all components of Arc View and will bring you back to the Project window.
B. In the Project window, go to **File** menu, click **Close Project**. It will ask you if you want to save changes. Say "No". Remember, you still have Arc View open.

Rule of thumb: "Close" Project, "Exit" Arc View program

Note: This is the safest way to close out of a Project. You can close Arc View and leave components open. This way when you open the Project again it will open exactly to where you left it.

CAUTION! Don't leave many components/windows open at a time and then close Arc View. This could cause Arc View to crash and possibly corrupt your Project.

NOTES:

2.2 Working with Themes

Themes

A View is a collection of *Themes*. A Theme represents a distinct set of geographic features in a particular data source. Themes are listed in the Table of Contents (Legend) at the left. Each Theme is listed separately and is displayed when the box in front of the Theme name is checked.

Spatial data can originate from ARC/INFO coverages or a Shapefile *(see Section 1).* Tabular data with *x, y* coordinates can be converted into a spatial format through Arc View. In addition, image data such as from orthophotos, quad sheets or satellite information can be used as Themes.

The characteristics of each Theme can be adjusted or controlled through "Theme Properties". This will be addressed in a later section.

Understanding what shapefiles are:

The shapefile format defines the geometry and attributes of geographically-referenced features in as many as five files with specific file extensions <u>that should be stored in the same project workspace.</u> They are:

1. **.shp** - the file that stores the feature geometry.
2. **.shx** - the file that stores the index of the feature geometry.
3. **.dbf** - the dBASE file that stores the attribute information of features. When a shapefile is added as a theme to a view, this file is displayed as a feature table.
4. **.sbn and .sbx** - the files that store the spatial index of the features. These two files may not exist until you perform theme on theme selection, spatial join, or create an index on a theme's Shape field. If you have write access to the source data directory, the index files will be persistent and remain after your Arc View session is complete. If you do not have write access to the source data directory, they will be removed when you close the project or exit Arc View.
5. **.ain and .aih** - the files that store the attribute index of the active fields in a table or a theme's attribute table. These two files may not exist until you perform Link on the tables. If you have write access to the source data directory, the index files will be persistent and remain after your Arc View session is complete. If you do not have write access to the source data directory, they will be removed when you close the project or exit Arc View.

Exercise 1 Copying Themes to Other Views

Arc View makes it very easy to copy and paste features into new Views. This is useful if you change the appearance/legend of a feature such as soils and you want to use that in another View. Instead of adding the Theme to a new View and resetting all of the properties, just copy and paste from an existing View. The projection will stay the same.

1. Copy Themes.

B. Open “usa.apr” Project. Go to *C:\esri\esridata\usa.apr* (*Figure 2.8*). If Arc View is open, go to **File** menu and click **Open Project**.

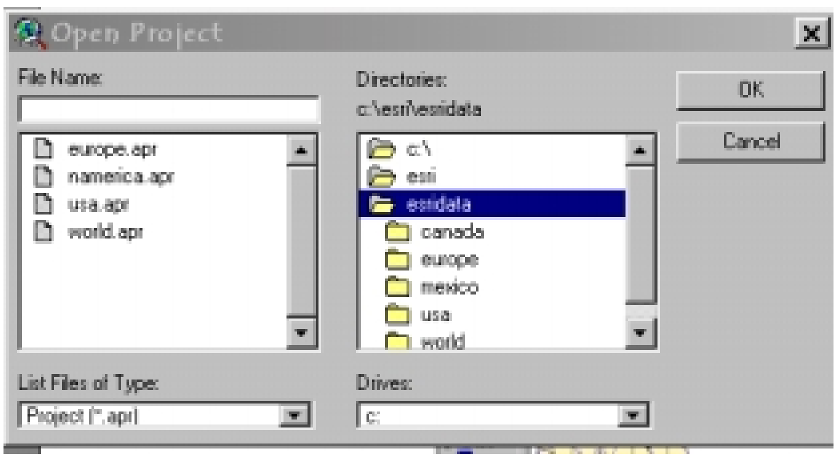


Figure 2.8

A. The View “Continental United States” will automatically come up. Make several Themes active at one time: “Major Highways”,“Major Rivers” and “US States”, by holding the *shift* key and clicking each Theme.

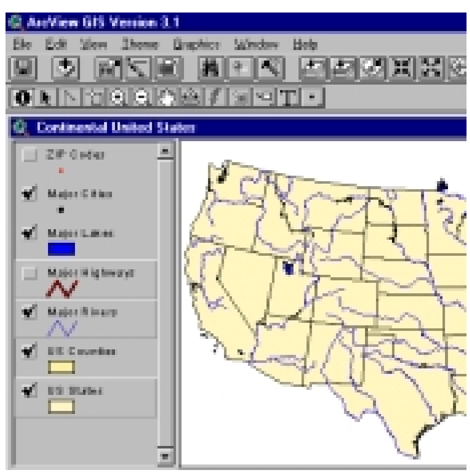


Figure 2.9

B. From the **Edit** menu, click **Copy Themes** or **Ctrl C**.

2. Paste Themes into a new View.

A. Go to the **Window** menu, click **usa.apr**. This will activate the Project window. Open a new View by double-clicking the View icon in the Project window.

> **Note:** The themes that were pasted are not projected because the original themes from "Continental United States" are not projected. They are virtually set to *Equidistant Conic* coordinate systems using View - Properties "Projection" settings.

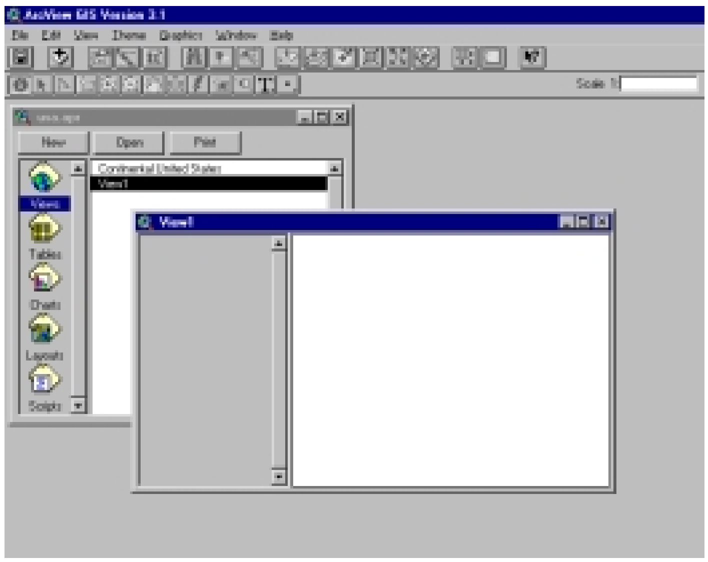


Figure 2.10

B. The new View called "View1" is active (blue bar at the top). Select **Paste** from the **Edit** menu.

C. The copied Themes will appear in the View with the same colors, symbols and same geographic area displayed.

D. Close this View and go back to theView, "Continental United States".

Exercise 2 Changing the Appearance of Themes

The Legend Editor is where you can change the look of the Theme: color, size, font, pattern, symbol, line width, etc.

1. Use the Legend Editor to change the appearance of Themes

Open the Legend Editor - 3 ways to do this:

Double click on a Theme in the Table of Contents OR

With the desired Theme active, click the "Edit Legend" button

OR from the **Theme** menu, select **Edit Legend**.

A. Change a Theme's color:

1. Make "Major Cities" the active Theme. At this scale you can't see the cities. Zoom in on Washington State until the points for the cities are visible.
2. Open the Legend Editor using a method above.
3. Double click on the Symbol "dot" (*Figure 2.11*).

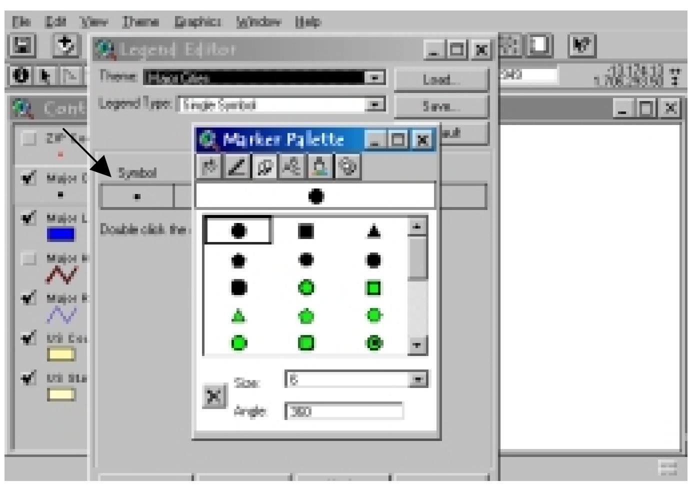


Figure 2.11

Note the Palette choices now available by clicking on the various buttons (Fill, Pen, Marker, Font, Color and Palette Manager - *Figure 2.12*).

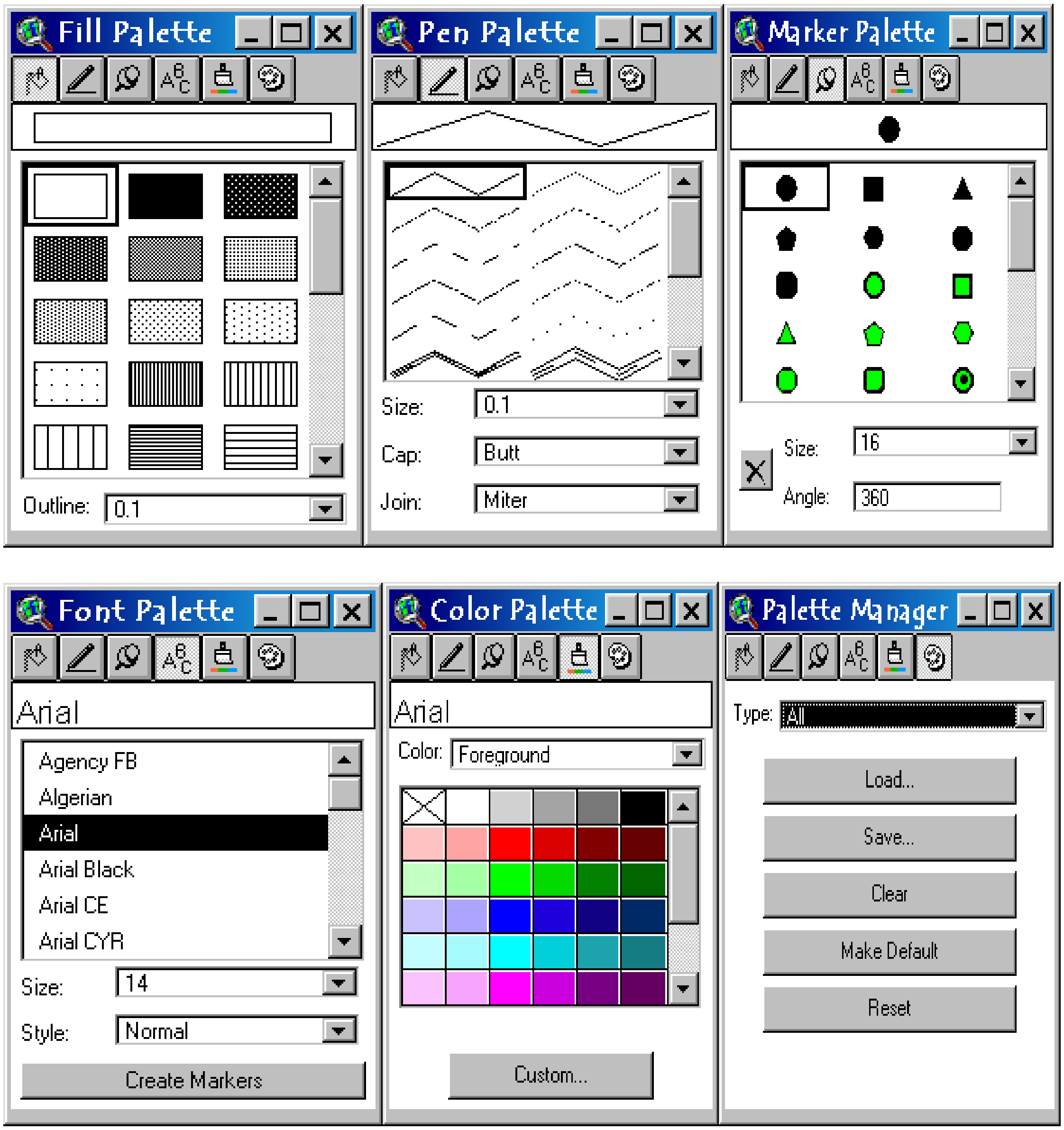


Figure 2.12

- Fill Palette – (polygon coverage) shades a symbol or changes the weight of outline
- Pen Palette – (line coverage) changes the appearance of the line
- Marker Palette – (point coverage) changes the symbol representing the point (i.e. circle, square, other)
- Font Palette – (text) adjusts font type, size and style
- Color Palette – (point, line, polygon, text) changes the color
- Palette Manager – add symbols to your palettes

4. Select the Color Palette and choose a color of choice.

5. Click “Apply” on the Legend Editor.

6. The View will re-draw with the newly selected color. Notice how the Table of Contents and View change.

7. With the Legend Editor still open, try a "Custom" Color:
   - Click on "Custom" on the Color Palette
   - In the "Specify Color" dialog box, move the bars for: *Hue, Saturation, Value* to get desired color. (*Figure 2.13*)

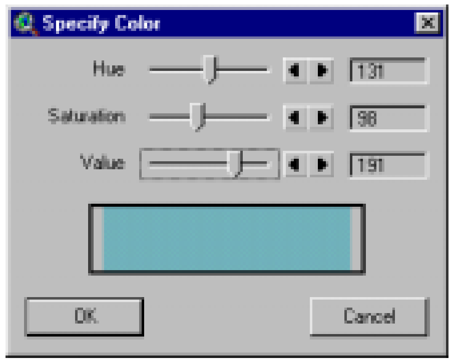


Figure 2.13

   - Click OK.
   - Click **Apply** on the Edit Legend box.

C. Change the Symbol of the Theme:

1. Select "Marker Palette" (the push pin) and change the symbol from a dot to a green star (scroll down to the star).

2. Change the size and color of the star using Marker and Color palette (*Figure 2.14*)

Figure 2.14

3. Apply the changes and close both dialog boxes.

E. Change outline width and fill of "Counties":

1. With the "Counties" Theme active, open the Legend Editor box.

2. Double click on the ‘Symbol’.

3. Open the Fill Palette dialog box (bucket spilling).

4. Change the Outline Width to “2” and the fill to “empty” *(Figure 2.15).*

5. Change color of County outline to light blue by changing the “Color” pulldown menu to “Outline” as shown in *(Figure 2.16).*

6. Click **Apply** on the Legend Editor Box.

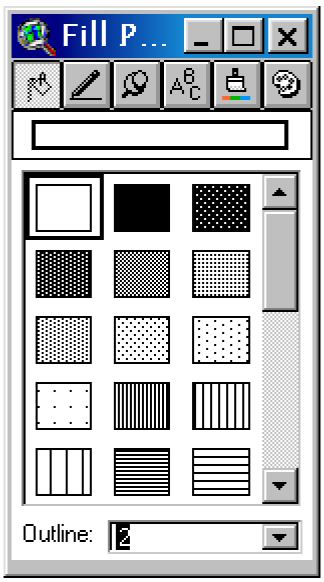


Figure 2.15

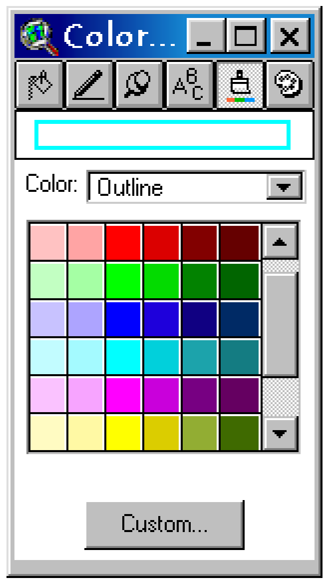


Figure 2.16

7. Close both boxes.

<u>2. Change the title of a Theme</u>

A. Make the “Major Rivers” Theme active.

B. Click the **“Properties”** button  OR go to **Theme** menu**,** Properties
In the “Theme Name” at the top of the dialog box, change the name to “Big Rivers” then click OK *(Figure 2.17).* It will appear in the Table of Contents exactly as you typed it.

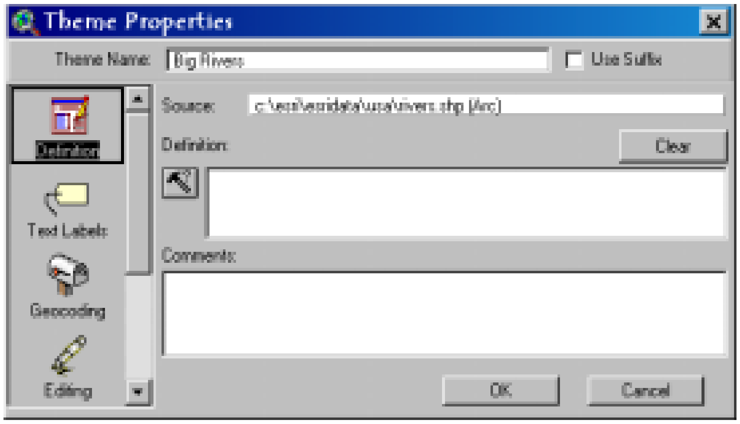


Figure 2.17

3. Classify the data

The legend of the active Theme can be classified in 5 different ways as shown in *Figure 2.18.* We won't be doing anything in the Chart legend type.

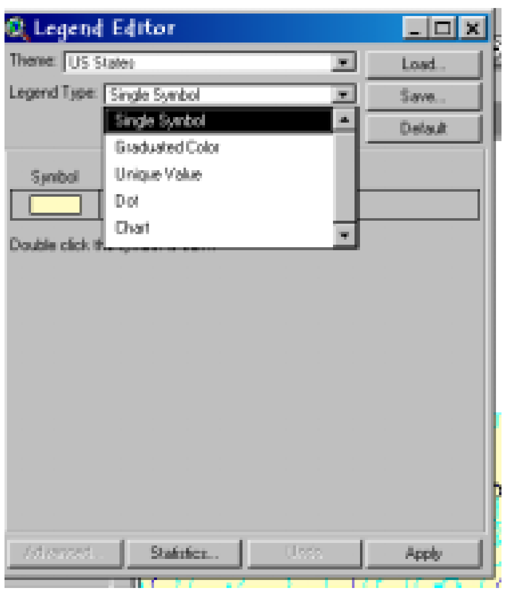


Figure 2.18

A. Use Unique Value to Classify the "US States" Theme:

1. Make "US States" the active Theme and zoom to see multiple states.

2. Open the Legend Editor.

3. Select "Legend Type" as **Unique Value.**

4. From the 'Values Field', select "State Name" and the data will automatically classify.

5. Change all the colors, if desired, by selecting a pre-selected Color Scheme (at the bottom of the dialog box)….OR….

6. Change the color of one or more of the categories by double clicking on the color to open the Color Palette box and selecting the desired color (or pattern) *Figure 2.19.*

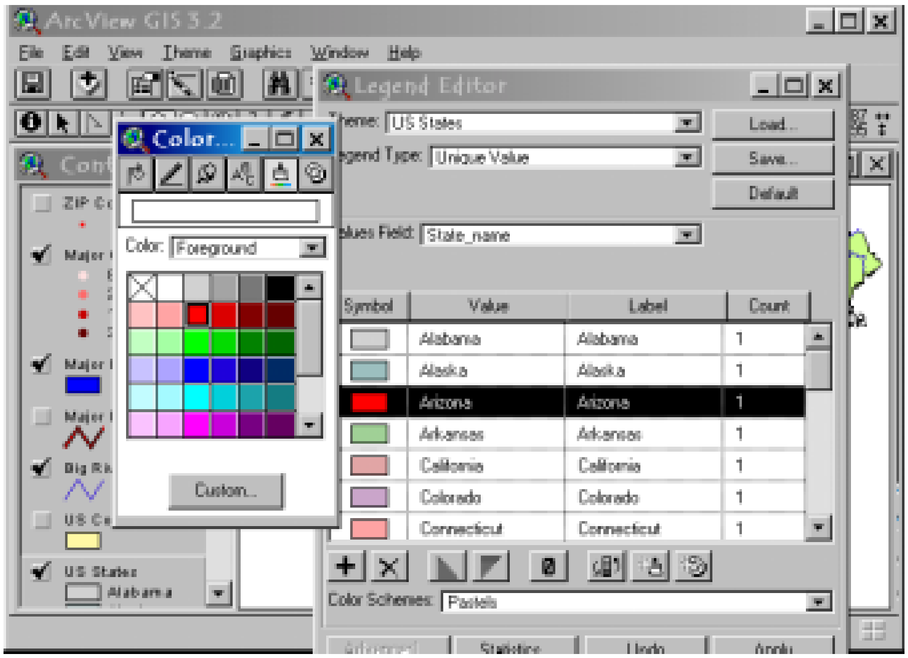


Figure 2.19

7. Apply changes and close the Legend Editor.

B. Classify by Graduated Color:

1. Activate the "Major Cities" Theme and zoom in on Washington State.

2. Open the Legend Editor dialog box.

3. Select Graduated Color as the Legend Type, and "Pop1990" as the Classification Field. It will default to 5 classes.

4. Change the number of classes to "4" by clicking Classify button.

5. Customize the legend: You can change the values by clicking on them and typing different ones. Click "enter" and what you typed will copy into the "Label" field. Note: The information in the label field will be displayed in the Table of Contents and Legend on your map.
    a. Apply new values as shown in *Figure 2.20.* Click tab key or enter key (both work).

b. Add commas to the values in the "Label" field.

Note: You can't add any values other than numbers in the "Value" field.

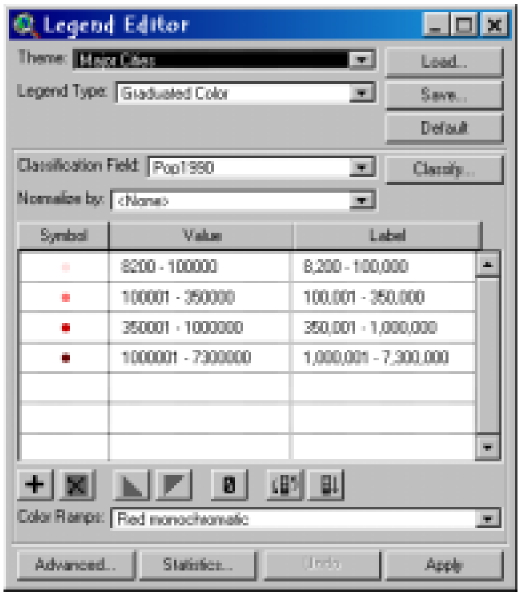


Figure 2.20

6. Apply changes then save the legend. To do this, click Save in the Legend Editor and select the folder in which you'd like to save custom legend. The file will have a *.avl* extension. Click "Default" in Legend Editor to bring back the single symbol legend. To re-load the saved legend, click "Load" in the Legend Editor and find the file you want.

Exercise 3 Adding Themes to the View

1. Add the Theme "places.shp" to the View of Continental United States.

Click the "Add Theme" button 

go to the directory in *Figure 2.21*. Select "places.shp" . Click "OK".

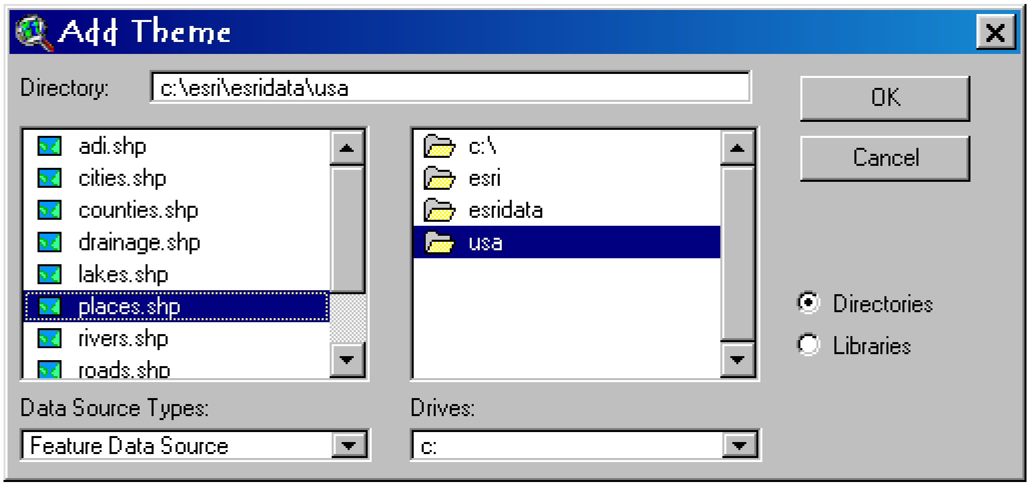


Figure 2.21

Notice that the Theme is added to the top of the Table of Contents. Note: If it is a polygon Theme or image file, you will need to click and drag it below the features you want to show. The name of the Theme has ".shp" at the end of it. If you don't want that to be the name in the legend then change it in Theme Properties 

Close the Project without saving changes.

NOTES:

2.3 Tables and Queries

When working with Tables in Arc View, rows and columns are called **records** and **fields**.

- A **record** is a row in an Arc View Table. If the Table is a Theme Table, each record corresponds to a single map feature[1].
- A **field** is a column in an Arc View Table. Each field contains the values for a single attribute[2].

The database file associated with the shapefile has the .dbf extension. These are always linked together. If you separate them in the directory, you will get fatal errors in Arc View. When you change the shapefile in the View, the .dbf is changed also; e.g., if you delete a selected feature in the View, that record is automatically deleted in the Table. The same is true if you add a feature; a record is added.

Exercise 1 Working with Tables

<u>1. Go into Arc View and make a new Project and new View.</u>

A. Go to **Fil**e menu, click **New Project**. Choose a new Project with a new View. Set the working directory to C:\gistemp by going to File menu, Set Working Directory (the default is C:\temp). Save the Project as “proj3.apr”.

B. Set the View Properties by going to **View** menu**, Properties.** Fill in the name, (“Tables”) map units, and distance units as shown in *Figure 2.22*. You can also put your name in as the creator, and add comments at the bottom.

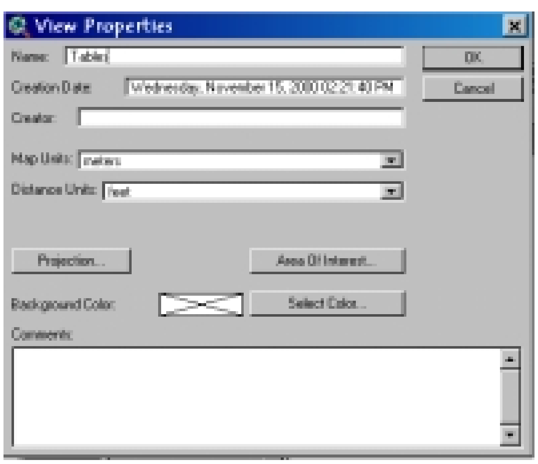


Figure 2.22

> **Note:** You can set your working directory to a specific folder in an open Project. Once you do this, after you add a theme, your working directory will be in effect. Every time you create a new theme or add a theme, it will default to your specified working directory. This saves extra steps in navigating.

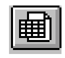
[1] From *Introduction to Arc View*, copyright 1992-1996, Environmental Systems Research Institute.
[2] <u>Ibid.</u>

CAUTION! Don't change the projection in View Properties because you don't need to. Your data will already be projected based on the projection the aerial photo is in.

Rule of thumb: Don't use this projection button!

<u>2. Add the Theme "fields.shp" in gistemp/data/farmplans. Open the Table and look at the contents.</u>

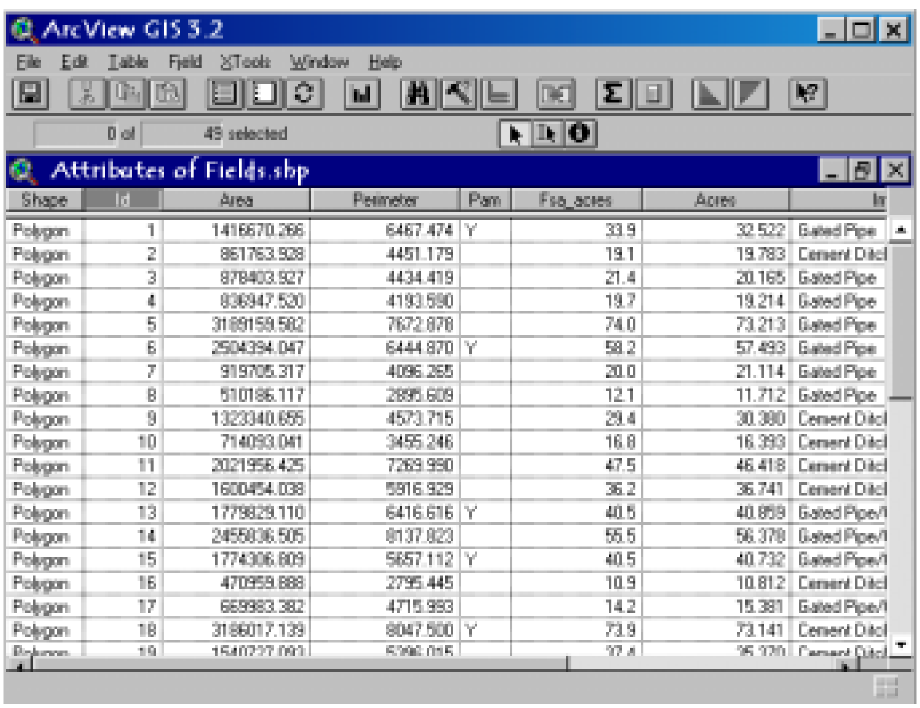
A. Add the Theme using the "Add Theme" button  and turn it on.

B. Click on the "Open Theme Table" button on the button bar 
The Table will be named "Attributes of fields.shp". This is a virtual database that is linked to the field features you see in the View.

Look at all of the fields. Use the scroll bar at the bottom if you can't see the full extent of the Table (*Figure 2.23).*

There are 49 records (visible above the name of the Table).

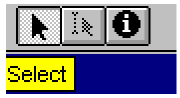
Notice that the Graphical User Interface is different than that of the View window. (refer to Appendix). Look at the menu and buttons to see what they do. You will be using the "Select" and "Edit" button regularly.



Shape	Id	Area	Perimeter	Pam	Fsa_acres	Acres	Ir
Polygon	1	1416670.266	6467.474	Y	33.9	32.522	Gated Pipe
Polygon	2	861763.928	4451.179		19.1	19.783	Cement Ditcl
Polygon	3	878403.927	4434.419		21.4	20.165	Gated Pipe
Polygon	4	836947.520	4193.590		19.7	19.214	Gated Pipe
Polygon	5	3189159.582	7672.878		74.0	73.213	Gated Pipe
Polygon	6	2504394.047	6444.870	Y	58.2	57.493	Gated Pipe
Polygon	7	919705.317	4096.265		20.0	21.114	Gated Pipe
Polygon	8	510186.117	2895.609		12.1	11.712	Gated Pipe
Polygon	9	1323340.655	4573.715		29.4	30.380	Cement Ditcl
Polygon	10	714093.041	3455.246		16.8	16.393	Cement Ditcl
Polygon	11	2021956.425	7263.990		47.5	46.418	Cement Ditcl
Polygon	12	1600454.038	5916.929		36.2	36.741	Cement Ditcl
Polygon	13	1779829.110	6416.616	Y	40.5	40.859	Gated Pipe/I
Polygon	14	2455036.505	8137.823		55.5	56.378	Gated Pipe/I
Polygon	15	1774306.809	5657.112	Y	40.5	40.732	Gated Pipe/I
Polygon	16	470959.888	2795.445		10.9	10.812	Cement Ditcl
Polygon	17	669983.382	4715.993		14.2	15.381	Gated Pipe/I
Polygon	18	3186017.139	8047.500	Y	73.9	73.141	Cement Ditcl

Figure 2.23

2. Select information about a feature from a Table.

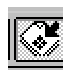
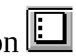
A. Click the "Select" button 

and click on a record. It will be highlighted in yellow. Hold down the *shift* key to select more records.

B. Click the "Promote" 

button to bring the selected records to the top of the Table.

C. Minimize the Table window. You should be back at the View window. Notice the features selected in the View are highlighted in yellow.

D. Click on "Zoom to Selected" button  to get a better view of the selected items. Click on "Clear Selected Features" button  to "unselect" any features and records selected.

E. Use the "Select Feature" tool *(Figure 2.24)* to drag a box around features you want selected. They will all be highlighted. Click the "Open Theme Table" button, then "Promote" button. All of the selected records will advance to the top and the amount of records selected will be listed as well *(Figure 2.25).*

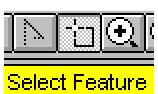


Figure 2.24

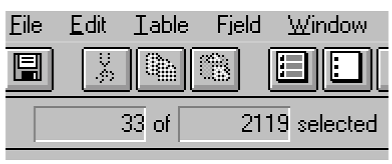


Figure 2.25

3. Hide fields in a Table

Arc View has a feature that simplifies the "look" of your table by "hiding" fields. The fields are no gone, just out of view.

A. Go to Table menu Properties and click in the "Visible" boxes where the checkmarks are. Click the checkmarks by the following fields: shape, area, and perimeter. You can also give a field an alias *(Figure 2.26).* Change "Id to "UnitNo". Rule of thumb – don't put spaces in field names.

B. Click OK. Look how the Table changed. To get the fields back, go back into Properties dialog box and click in the "Visible" boxes.

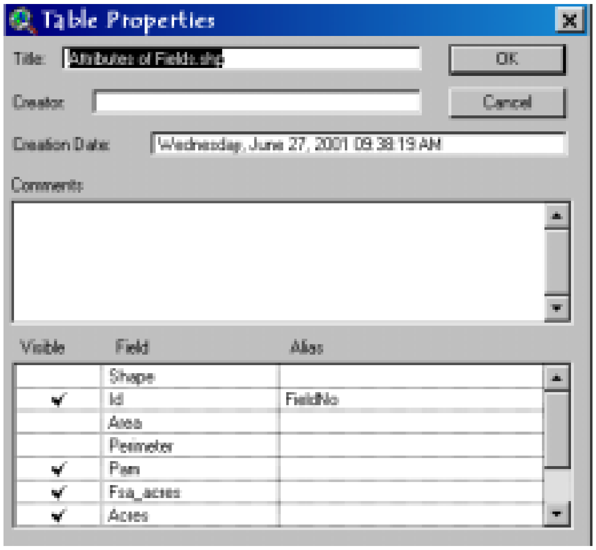


Figure 2.26

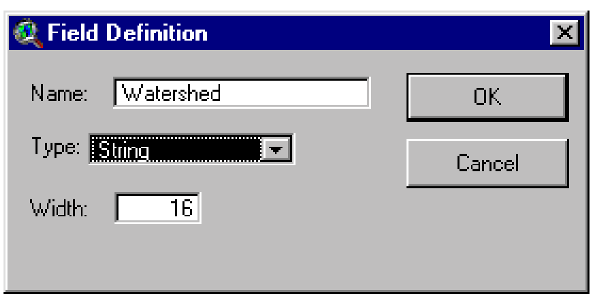
4. Create a new Table

In this exercise you will create two Tables that aren't linked to spatial features. Then you will join and link the tables to see the relationships.

A. Go to the Project Document Window and select the *Tables* icon.

B. Click "New" button (New Table dialog box opens). Keep the default name, "table1.dbf".

C. A blank Table opens. Go to **Edit** menu, select **Add Field** (this names a Column Heading). When the Field Definition dialog box opens, fill in dialog box as shown below. Click OK.



D. Add another Field for the other column heading:

Name – Farm Plan
Type – String
Width - 16

E. Now, add records by going to the **Edit** menu, **Add Records** (or use Control A).Repeat this five times to add 'place holders' for that many records.

F. Using the "Edit" tool, click on the first field of the Table and fill out as shown in *Figure 2.27*: use the Tab key to move around the Table.

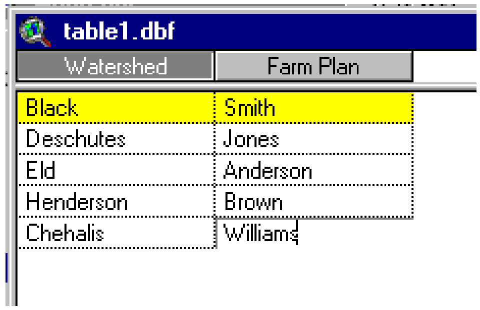


table1.dbf

Watershed	Farm Plan
Black	Smith
Deschutes	Jones
Eld	Anderson
Henderson	Brown
Chehalis	Williams

Figure 2.27

G. When Edits are complete, go to the **Table** menu and select **Stop Editing**. Save the edits.

H. Make a second Table by following the steps above. Keep the default name, "table2.dbf". The field names will be "Farm Plan" and "Acres". Fill in the records as shown below in *Figure 2.28.*

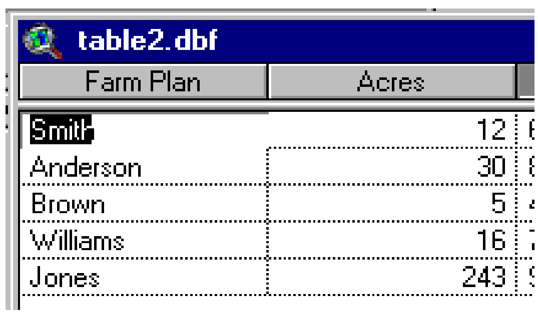


table2.dbf

Farm Plan	Acres
Smith	12
Anderson	30
Brown	5
Williams	16
Jones	243

Figure 2.28

<u>5. Rename the Tables in Arc View Project window</u>

A. Go back to the Project window and select "table1.dbf". Go to the **Project** menu and click **Rename** (*Figure 2.29*)**.** Name the table "Farm Plan Watersheds".

B. Rename second table to "Farm Plan Statistics."

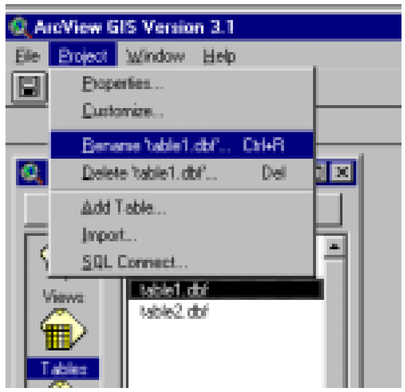


Figure 2.29

6. Join Tables

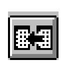
When joining Tables in Arc View one Table will be the "source" Table and one will be the "destination" Table. You are appending all of the data fields and records from one Table (source) to the existing fields and records of the other Table (destination). To do this you have the same field in both Tables.

Note: the data has to be the same, but the field name can be different. When joining or linking Tables, both Tables must be viewable at the same time. You can do this by "Tiling" the windows.

A. Go to Window menu, click Tile. Make "Farm Plan Watersheds" the active Table. (This will be the "source" Table). Highlight the column heading " Farm Plan" by clicking on the field name (the column heading will be depressed).

B. Now make "Farm Plan Statistics" the active Table. (This will be the "destination" Table). Highlight the column heading "Farm Plan".

C. From the Button bar, select "Join Tables".



D. Look at the information appended to "Farm Plan Statistics".

E. Remove joins by going to **Table** menu, **Remove All Joins.**

> **Note**: Joined and linked Tables will stay that way until you remove the join/link. You can save a joined table by making a copy or if it is part of a shapefile, "Convert to Shapefile".

7. Link Tables

When linking Tables you are seeing the relationship between selected records that have common fields and records in both tables. You can only link to the "destination" Table.

A. Make sure you have both Tables viewable at the same time.Click on the field name “*Farm Plan*” in “Farm Plan Watershed” (source Table) (note the column heading depresses in).

B. Click on the field name “*Farm Plan*” of “Farm Plan Statistics” (destination Table).From the Table menu, select Link.

C. With the “Pointer” tool, click on records of “Farm Plan Statistics”. Notice how related records are highlighted in the source Table.

D. Clear any selected features and remove Joins.

E. Exit out of both tables.

Explanation of Joining and Linking:

Join - You can join a table to the active table based on the values of a common field found in both tables (active table is the one that has the colored bar at the top with the Table name). Join establishes a one-to-one or many-to-one relationship between the destination table (the active table) and the source table (the table you are joining into the active table). Typically, the source table contains descriptive attributes of features that you wish to join into a theme's table so that you can symbolize, label, query and analyze the features in the theme using the data from your source table.

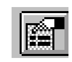
Link- Unlike joining tables, linking tables simply defines a relationship between two tables, rather than appending the fields of the source table to those in the destination. When tables are linked, neither table is changed – one is just linked to the other. After a Link is performed, selecting a record in the destination table will automatically select the record or records related to it in the source table. If the destination table is the feature attribute table of a theme, selecting one of the theme's features in the view selects that feature's record in the attribute table, and therefore automatically selects the records related to it in the source table. Selecting a record in the source table does not select the corresponding record in the destination table. *This is because the link only exists in the destination table.*

You can link a table to the active table based on the values of a common field found in both tables. Link establishes a one-to-many relationship between the destination table (the active table) and the source table (the table you are linking to the active table). One record in the destination table is related to one or more records in the source table. Typically, the source table contains descriptive attributes of features that you wish to link to the features in a theme's table so that you can select features from this theme on a view see which linked records in the source table are selected.

Exercise 2 Queries

This exercise demonstrates two ways to query a Table. The Query Builder is a simple way to extract specified data from the Table.

- The first is by using the Query Builder button.  This type of query will highlight the results of the query while still showing all features in the Theme.

- The second is by querying data through **Theme-Properties.**  This type of query will change the View to show only the results of the query. If you want to show the Theme with all of its features again, you must use the Clear button in Theme Properties. You won't be able to query the complete data set until you clear the query.

1. Use the Query Builder button in the GUI to highlight the selected features.

A. Make sure the Theme you want to query is active; in this case "fields.shp".

B. Use the Query Builder tool  and enter the data in the query dialog box as shown in Figure 2.30. Double click "Z9_type". Single click "=". Double click "Timothy". If you don't follow these instructions exactly you can get syntax errors.

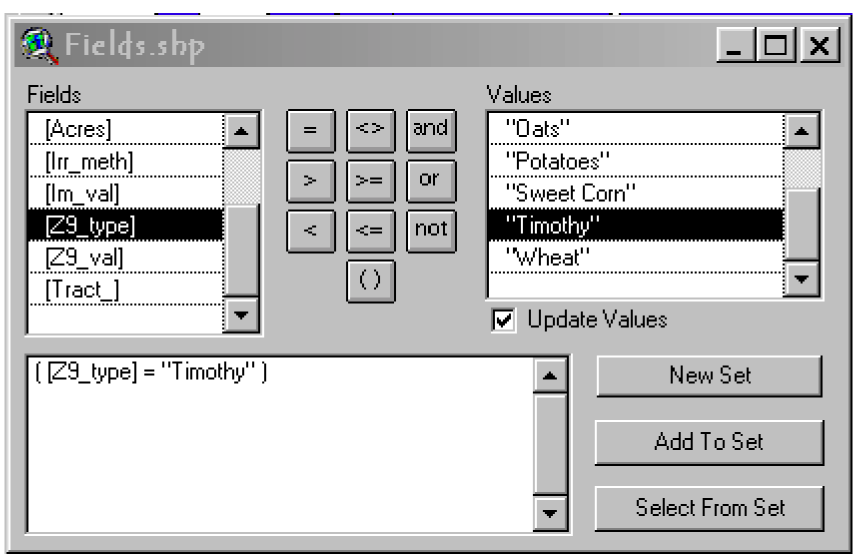


Figure 2.30

C. Click **New Set**. Open the Table. The areas that meet the selection criteria will be highlighted in yellow in the Attribute Table and in the View.

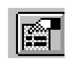
Rule of thumb: Cross reference queried data for accuracy by looking at the table.

D. Clear Selected features.

Querying Tips:

New Set - Makes a new selected set containing the features or records selected in your query. Features or records not in this set are deselected.
Add To Set - Adds the features or records selected in your query to the existing selected set (for the same Theme only). If there is no existing selected set, the features or records specified in the query become a new set. Use this option to widen your selection.
Select From Set - Selects the features or records in your query from the existing selected set. Only those features or records in this existing set that are selected in your query will remain in the selected set. Use this option to narrow down your selection.

2. Use the Query Builder under Theme-Properties to show only selected features.

A. Open the Theme Properties dialog box.  *(Figure 2.31).*

B. With the Definition icon highlighted in the left scroll list,

click on the Query Builder tool.  Notice that in this dialog box you don't have a choice in adding or selecting from the set *(Figure 2.32).*

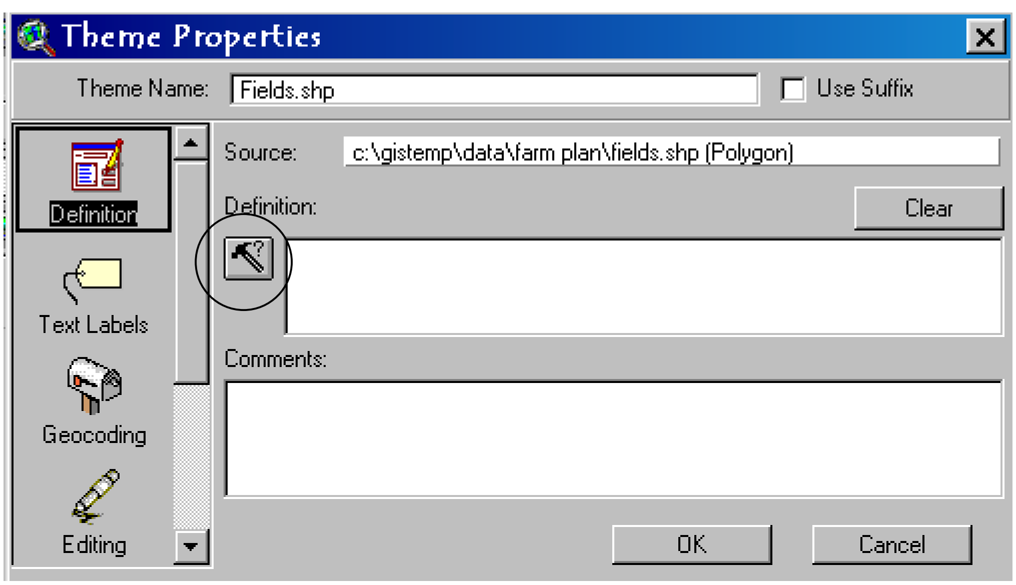


Figure 2.31

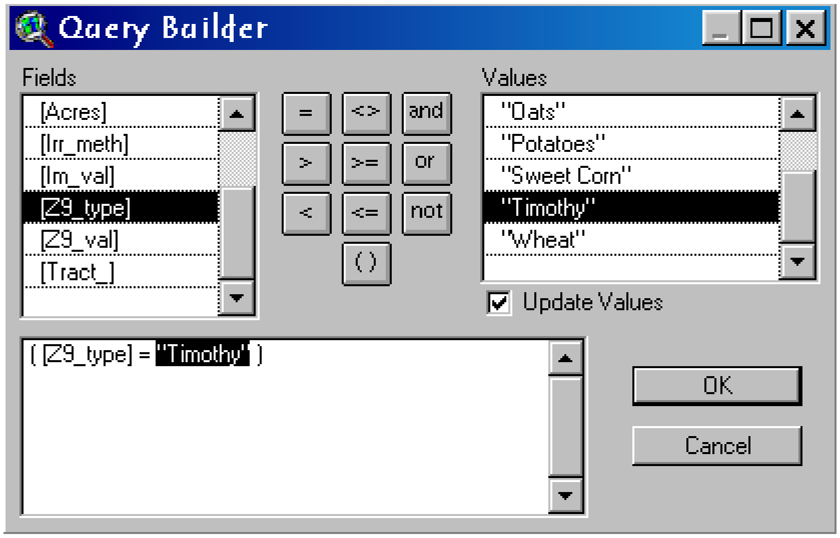


Figure 2.32

C. Click OK. Notice that only the features in the query are showing in the View and only those records are in the Table.

Go back to Theme Properties and click the “Clear” button, then “OK” button (in that order) to see all of the original features. This is the only way to clear the selection. Until you clear the selection you can’t do anything with the unselected data.

<u>3. Select and Delete features in the View window.</u>

To do any type of editing, you must start the process first. Once you are in the “edit” process, a dashed box will appear around the check mark of the selected Theme.

A. Make the View window active. Make sure you have cleared you previous query. Go to Theme menu, Start Editing (details on editing covered later).

B. With the Pointer tool  click on a polygon. Squares called “handles” will be around the selected feature. Open the Theme Table to make sure the feature you selected in highlighted in yellow *(Figure 2.34*).

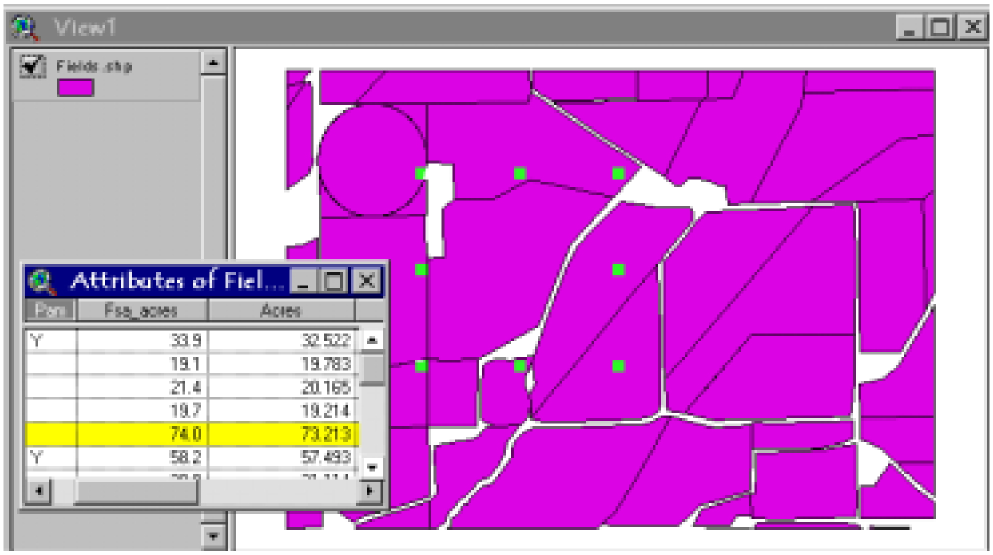


Figure 2.34

C. Delete the selected polygon by pressing “Delete” key on your keyboard. Note that Arc View won’t ask if you really want to do this. The record associated with this feature will be gone as well.

You can also delete records in the Table window by going to **Edit** menu, **Delete Records**. (The Delete key on the keyboard won’t work here).

To recover deleted features in a View, go to **Edit** menu, **Undo Feature Edit**. To recover deleted records in a Table, go to **Edit** menu, **Undo Edit**.

D. Stop editing and save changes. Leave the Project open.

Note: The second day will cover making new Themes and populating Tables.

NOTES:

2.4 Buffering

Buffering can be a very useful tool for Conservation District GIS applications. Any point, line or polygon feature can be buffered. The Buffer Wizard tool along with the X-Tools extension can be used to determine the area, perimeter, and length of the buffered areas.

EXERCISE 1 Using the Buffer Wizard

In this exercise you will learn how use the Buffer Wizard to create a buffer around stream segments. (Note: The Buffer Wizard extension is included with Arc View version 3.2).

<u>1. In proj3.apr, make a new View and call it "Buffer". Be sure to set the map and distance units to feet. If you do not do this the Buffer Wizard will not work.</u>

<u>2. Add the following Themes located in C:\GIStemp:</u>

- henderculverts.shp
- henderstreams.shp

<u>3. With the Zoom In tool, zoom into the streams in the upper portion of the View as shown in *Figure 2.35*</u>

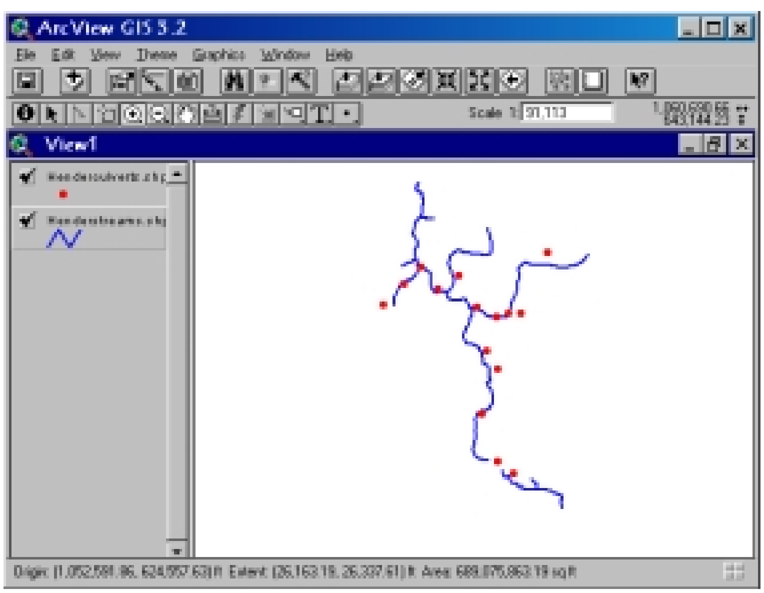


Figure 2.35

<u>5. Make the "henderstreams.shp" Theme active and choose the "Select Feature" tool.</u>

Select all of the streams in the View.

6. Go to Theme - Create Buffers.

The Buffer Wizard dialog box comes up (*Figure 2.36*). Click “Next”.

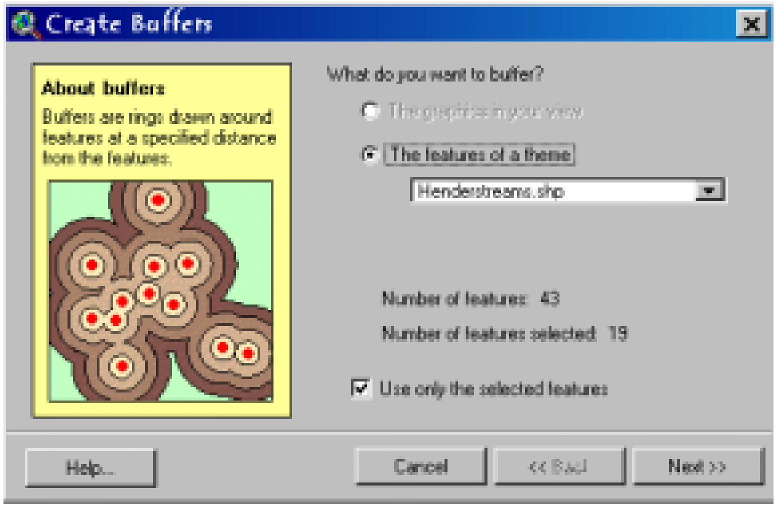
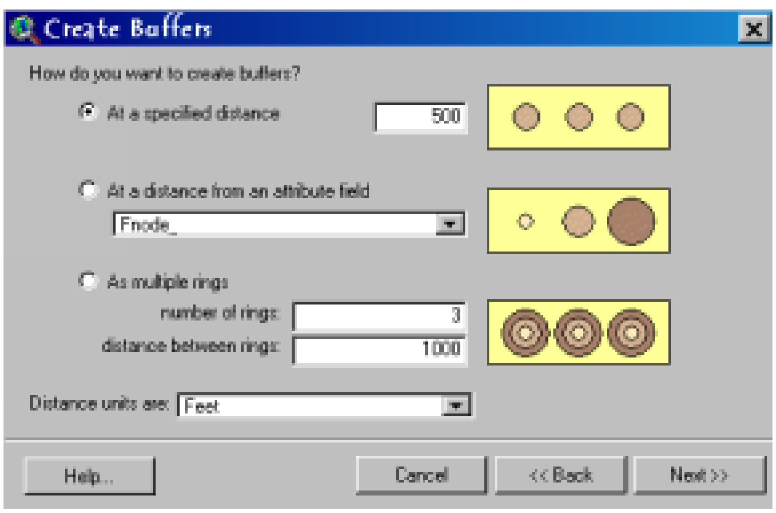


Figure 2.36

7. Create buffers at a specified distance of 500 feet (*Figure 2.37*). Click “Next”.



`

Figure 2.37

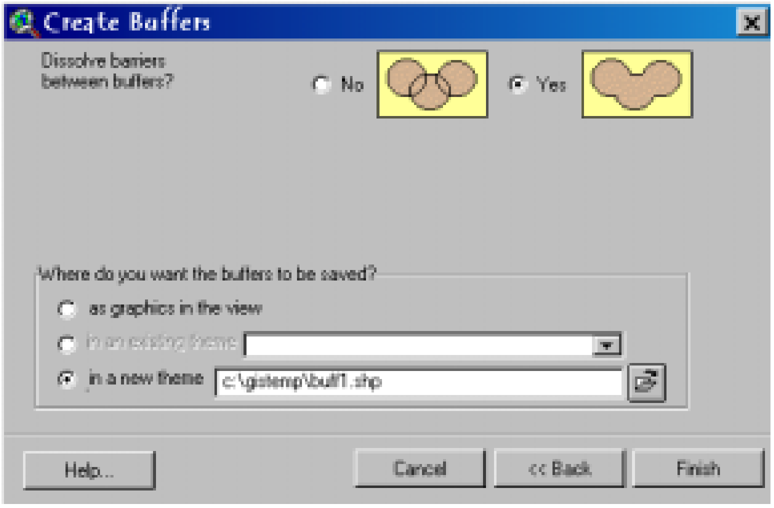


Figure 2.38

<u>8. Dissolve barriers and save the buffer as a new shapefile in the GIStemp folder (*Figure 2.39*). Click "Finish".</u>

The new buffer theme will be at the top of the Table of Contents. Move it to the bottom. You should now have something that looks like *Figure 2.39*.

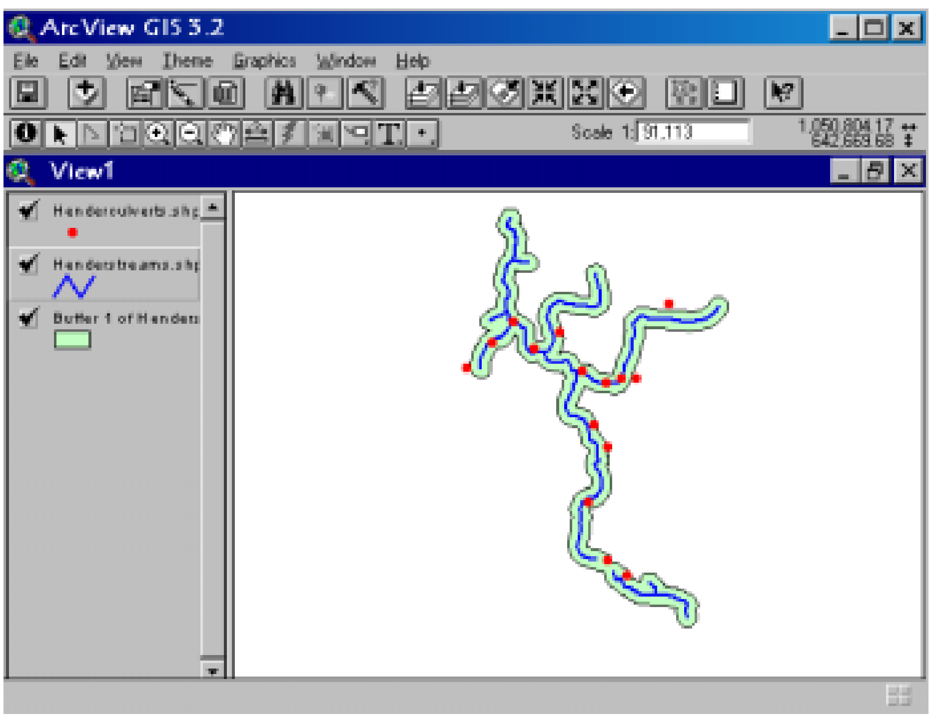


Figure 2.39

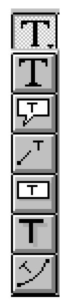
<u>7. Go to File menu, Close All , and save the Project. In the next exercise you will open an existing Project.</u>

2.5 Labeling & Layouts

Labeling

In Arc View you can label features' attributes from the table, or add text in different forms, road symbols, etc. *(Figure 2.40)*. Labeling can be easy in Arc View, but the more features, the more time consuming the process is. If you want to label many features at one time, it can be arduous. The labels may not be the correct size to fit in the area, they may be shifted to the left or right. Exercise 1 will address these issues.

These label tools label s data from the "attributes of" table.



The text label tools allow you to enter custom text in various ways.

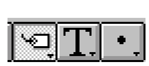
Figure 2.40

Exercise 1 Labeling

1. Open Project and set scale

Open the "namerica.apr" Project. Zoom in on Mexico and set the scale to 1:3,000,000. Be sure all Themes in Canada and the US are turned off, and that all the Themes in Mexico are turned on.

A. Make sure you don't have editing started. You can't label if you are in edit mode. Make "Mexican Rivers" the active theme. Go to Theme menu, Properties. Click on the "Text Label" icon. "Label Field" should be "Name" and the alignment should stay as the default in *Figure 2.41*. The "Scale Label" check should be on. Click OK.

B. Click the Label tool  Now click on a river feature. The river name will appear.

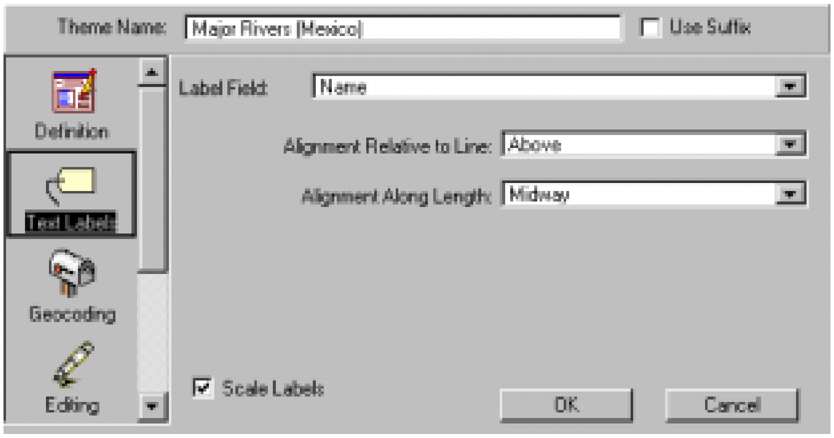
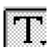


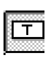
Figure 2.41

2. Use the various text tools shown in Figure 2.39 (the tool picture tells you what it will look like)

 Click in the area you want to place the text. The text dialog box will come up. Type “River”. Click OK.

 Click the feature, and drag. A box will appear for text. Type “River”.

 Click and drag. Type “River”.

 Click and type “River”

 Click and type “River”

 Adds text that’s aligned to a splined base line like a waterway. Click along a linear feature then type “River” or a longer name to see the affect.

Note: It is a good idea to set the font size before you begin labeling. The size of the font defaults to size 14. Most of the time you will want a smaller font size. To change it go to Window menu, Show Symbol Window (Ctrl P). This brings up the Font Palette. You can change the font size, type, and color (To change the color, click the Color Palette and change the “Color” to “Text” in the pull down bar). A good size to work with is “7”.

2. Auto-Label

Auto-Label is useful if you have many features, but you will still have to reposition and resize to fit on your map properly.

A. Zoom out to 1:25,000,000. Make the “States (Mexico)” the active Theme. Go to the Window menu, Show Symbol Window and set your font size to “7”.

B. Go to Theme menu Auto-label. Set the properties as shown below in *Figure 2.42*. Note: If you click the "Label Only Features in View Extent" then if won't label the entire Theme (which can take a long time if it's a large data set).

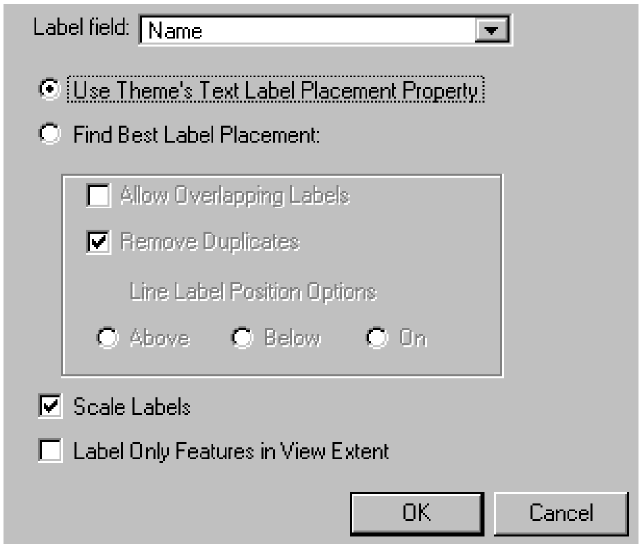


Figure 2.42

C. Notice where the labels are. Some may need to be moved. Zoom into an area where you need to edit. Click the pointer tool  then click the label tool. Click a label. Once it has crossed arrows, drag it where you want it.

D. To remove all of the labels, go to Theme menu Remove Labels or go to Edit menu, Select All Graphics and click "Delete" on your **keyboard. If you** needed the labels you just removed, there is a safety net: "Undo Graphic Edit" in the Edit menu.

Layouts

A layout is a map that lets you display views, charts, tables and imported graphics. The layout is used to produce maps for printing. In your case you will be mainly displaying views. In a layout you add text, scale, north arrow and graphics.

The same data can be displayed on a number of different layouts. Think of each layout as being a different way of presenting the data.

Printing layouts
You can print a layout or export a layout to a number of formats to use with other software packages.

The following exercise is going to show you two ways to make a layout. I highly recommend using the second method for better control of how your map will look.

Exercise 2 Layouts for Printing Maps

1. Make an easy Layout

A. Select any View that you want a layout for.

B. With the View open go to the View menu, select Layout.

C. The dialog box as shown in *Figure 2.43* will come up. Select the top template. Click OK

D. The map will look like Figure *2.44.*

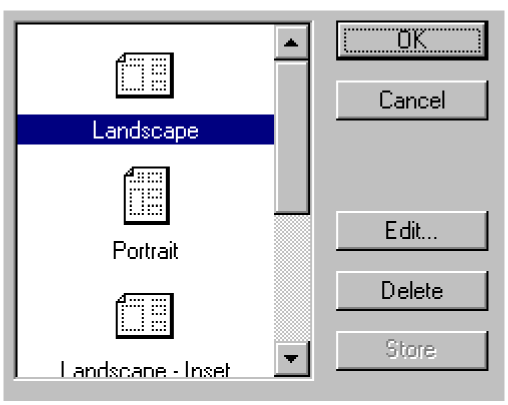


Figure 2.43

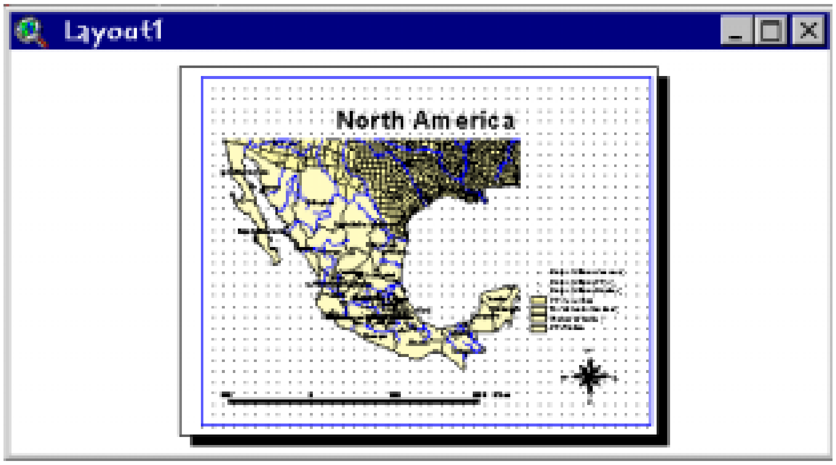


Figure 2.44

The disadvantage of this method is that it is not a good design. You would want to move all of the objects, resize, change fonts, etc. It doesn't save time. Making a custom layout is more productive because you make the map exactly how you want it.

2. Make a custom Layout

This method allows you to be specific about what you want in your Layout. You have Layout tools to add the View, legend, scale, north arrow, graphics, tables and charts *(Figure 2.45).* You will only be adding Views, legend, scale and north arrow in this exercise. You can also add a title, disclaimers, etc. using the Text button .

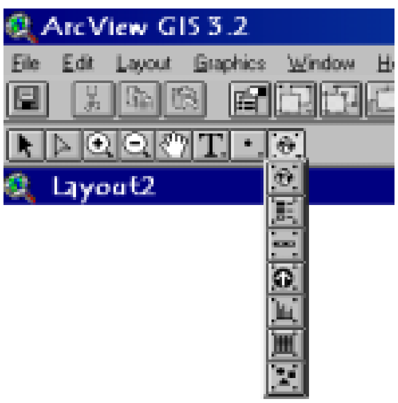


Figure 2.45

A. Make a layout of the same View. Tile the open windows. Make the Project window active. Click on the Layout icon.

B. Click on "New". A new layout with the title "Layout1" will appear. It will be completely blank. It defaults to portrait size of 8 ½ x 11.

C. Set the size of the layout first! Very important to follow these steps (sse note box below). Go to Layout menu, Page Setup *(Figure 2.46).*

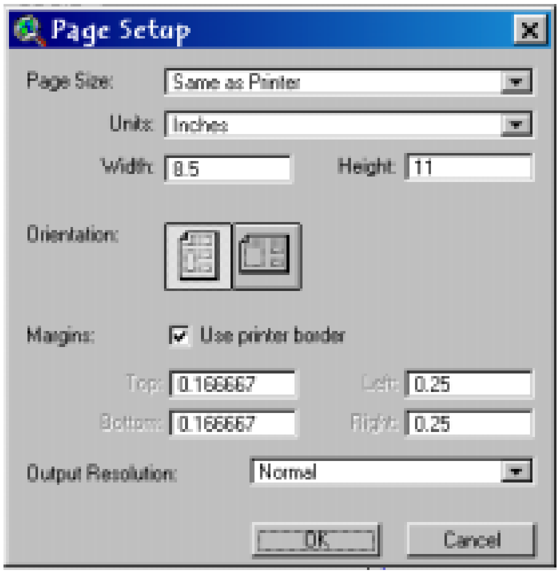


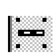
Figure 2.46

D. After looking at your page size choices, leave it at portrait 81/2 x11.

> **Note:** Once the size and orientation of a Layout is set and a map is made, if you change the Page Set-up, the objects in the Layout will not change size to fit in the new sized Layout. Dragging the View frame can distort the scale.
>
> <u>Always set up the Layout before you add map objects.</u>

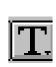
E. Click on View Frame tool . The View Frame brings your selected View into the Layout. After clicking the View Frame tool, draw a box where you want your map to be. A dialog box will come up which asks you which View you want. Select "North America" then OK. (If you have multiple Views open they will be listed as options to choose from).

F. Click on the Legend tool  and draw a box in the area you want your legend. This comes from the Table of Contents in your View. Choose "North America" as the View you want the legend from. Select OK.

G. Click on the Scale tool  and draw a box where you want your scale.

H. Choose "North America" for View you want the scale for. It will have automatic settings. Leave these as is for now. Select OK.

I. Click on the North Arrow tool  and pick the default arrow. Select OK.

J. Add a title by clicking the "T" tool  click anywhere you want your title and type in "Soil Types". Accept the default settings and select OK.

Now you are ready to "clean up" your layout. All of the objects you just added to the map can be changed in size, appearance, value, etc. Currently your map may not look like the final product for output. Follow these guidelines to design your map display.

3. Adjust the settings of the objects in the Layout

Note: By double clicking on any map object in a layout, you can change it's properties.

A. Turn off "Snap to Grid" to move objects easily: Go to Layout menu, Properties (Figure 2.47). (This is a personal preference. If you leave the Snap to Grid on, then you can only move objects within the set grid spacing). Click OK. You can also Name your layout here. Name it "South America".

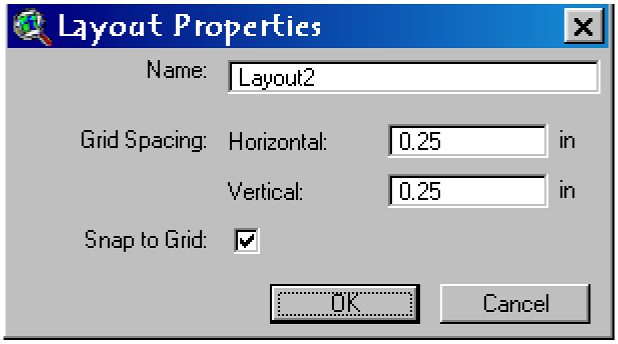


Figure 2.47

B. Make sure your Pointer tool is selected and click on the legend to select it. Once it is selected it will have "handles" or squares in four corners of the arrow around it *(figure 2.48)*. When the Pointer tool is over the selected arrow, there will be cross arrows meaning you can move it (just like you moved labels in the View). Practice doing this with the legend and scale bar.

Figure 2.48

C. Resize your title: Click on the title. When the handles appear, the title is selected. Move your cursor to the right bottom handle and when you see a diagonal arrow drag it to make the title bigger. Now click the title to center it with the map View.

D. Change the scale from a bar scale to a ratio scale. Double click on the scale to open the scale properties dialog box. The View Frame will already be selected to "North America". Change the "Style" to "1:10000". Click OK. Notice how the scale changed. If you can't see it clearly zoom in using the zoom tools.

E. Rename the Theme "States (Mexico)" to "S America" in the legend. To do this you need to go back to the View window. Go to Window menu, and click on "North America". Go to Theme menu, Properties and type in the new name. Now go back to the open Layout. Notice the change. If if doesn't change, right click the mouse and click "Refresh" toward the bottom.

Note: Additional functions in Layouts: Grouping, Aligning, Neatlines. See Help Topics-Laying out and Printing Maps- Drawing on a Layout.

F. Printing Layouts: Double check you Layout page settings in **Layout** menu**, Page Setup** with the **File** menu, **Print Setup** settings to make sure they are the same. Use ArcPress for printing large map. Print "Draft" quality first to see if your layout is correct. plots with aerial photography as the base.

4. <u>Save changes and close the Project.</u>

<u>Helpful Hints for Layouts:</u>

<u>Include a date and metadata</u>

<u>Include a disclaimer:</u>

Disclaimers are essential for GIS technicians. Remember that maps depict what the cartographer wants them to. When there are known discrepancies in the data, or if it is used for general purposes it should say that somewhere on the map. The disclaimer used by Kittitas County Conservation District is:

> "Maps developed by Kittitas County Conservation District meet or exceed national map accuracy standards of + or – 20 feet used in the development of NRCS digitized soil survey".

This disclaimer is for the farm tract and field boundary GIS data that KCCD developed.

The disclaimer can be the small print in the bottom corner.

<u>Remember who will be using the map. Does it meet those needs?</u>

3.1 Creating Spatial Data

This section will focus on creating new data by means of on-screen digitizing using a mouse (see Section 1).

Important factors to consider when creating new data (e.g. crop data, watershed data, etc.):

- Does the same data exist elsewhere? Don't reinvent the wheel! Research! Research! Research! Call around.

- What projection and coordinate system does the data need to be in?
  - If you are using image data as a base map, then what projection is it in? You will want other Themes in the same projection as the image file.

- What accuracy standards do you need to follow?

Once you have determined that creating data is a must, you are on your way to taking the next step…Just do it!

Exercise 1 Create a New Project & View

1. Make a new Project with a new View (*Figure 3.1*). Save it as proj4.apr.

Remember to set the working directory to C:\gistemp by going to **File** menu, **Set Working Directory**. Save the Project as "proj4.apr".

A. You will be prompted to add a new Theme once the View opens. Add an image Theme. The "Data Source Type" should be *Image Data Source*. Navigate to C:\GIStemp. Click on the file, "T17NR19E.TIF". Turn on the Theme.

Figure 3.1

B. Go to **View** menu, then **Properties** and name the View, "Image". Set the Map and Distance Units to "Feet". Now you can see the scale.

C. Change the scale to 1:20,000. Now the features are more viewable.

Note: If the image appears too dark, you can lighten it by clicking on the image Theme in the TOC *(see Figure 3.2).* Click on "Linear" button and drag the middle 'square' toward the upper left corner. Click on "Apply" to see the results. If you need to make another adjustment, go back.

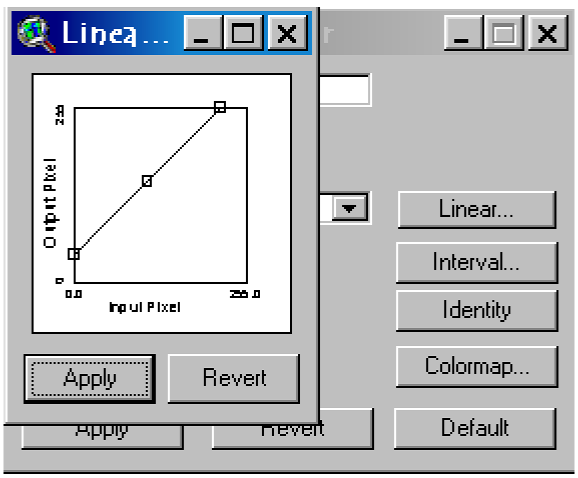


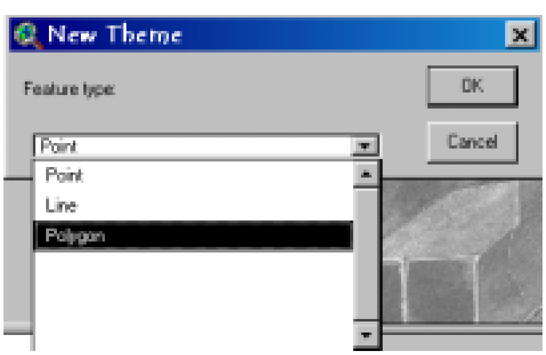
Figure 3.2

Exercise 2 Create New Theme & Table

The following exercises will teach you how to create a new polygon Theme, populate the Table, and edit the features.

<u>1. Create a new Theme</u>

A. Go to View menu, New Theme. Choose Feature Type "Polygon." (Figure 3.3)



i.

ii. Figure 3.3

B. Leave it as the default name, "Theme 1" and save it to the C:\GIStemp directory.

C. The new Theme has been added to the table of contents. You won't see anything until you create some polygons.

2. Set up the Database Table

A. Click the "Open Theme Table" button in the View. Notice that a Table was automatically created when you made a new Theme. It only has a "Shape" & "ID" field *(Figure 3.5).* The "Shape" field indicates what type of feature it is (point, line, or polygon) and the "ID" field is created for you to use as a unique ID for each record (feature). For example, if you want all of your records to have a unique identifier, then give them number 1 through "last number of record").You have to build the rest of your table by adding Fields.

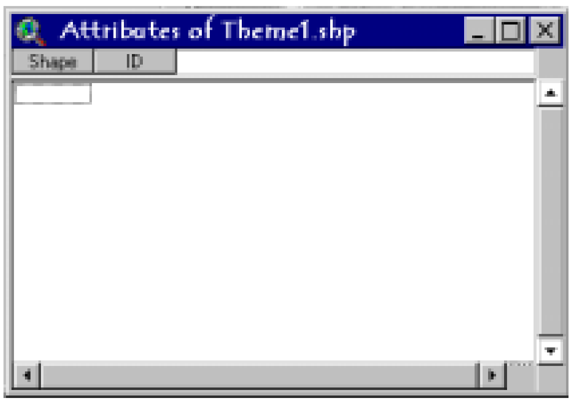


Figure 3.5

B. Go to Table menu (note that you are already in edit mode).

C. Go to Edit menu and "Add Field". The Field Definition box comes up *(Figure 3.6).* Change the default settings to:

Name = *"Tract No."* Type = *"Number"*
Width = *"7"* Decimal Places = *"0"*

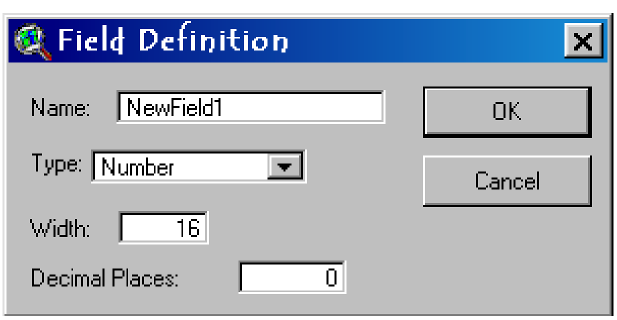


Figure3.6

Note: Once you set the database field definition settings, they cannot be changed in Arc View. If a field is not wide enough text or numbers will be cut off. To avoid this plan ahead, start over or export the table into another database program such as Excel or Access, make your changes and import that file back into Arc View. ***Caution*** when changing a database (.dbf file) and bringing it back into Arc View, always make a copy of the .dbf file before making any changes…just in case!

Exercise 3 Digitizing Polygons

This process involves placing vertices (points/nodes that make up a polygon) along a specific feature until a polygon shape matches the shape that was traced.

To accomplish this, have hard copy reference material on hand (e.g. FSA photo, quad map, digital ortho photo, tax parcel map, etc.) and do the following:

1. Set Snapping Tolerance (important to do this first!)

A. Go to **Theme** menu, **Properties** and click on "Editing" icon *(Figure 3.7)*

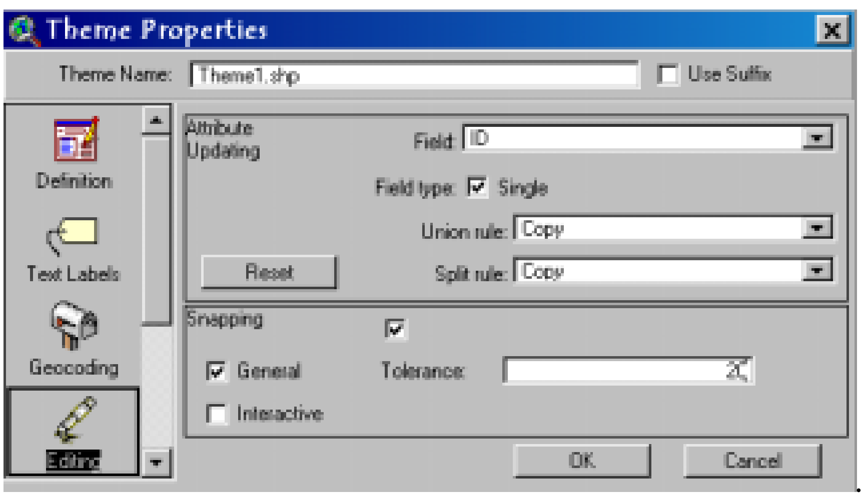


Figure 3.7

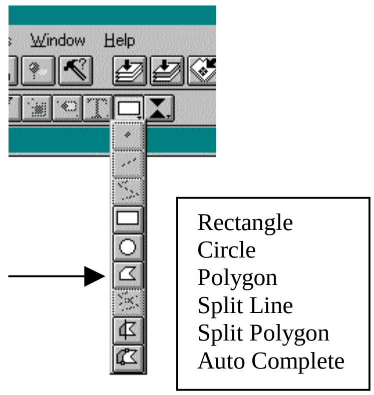
B. Set *General* snapping tolerance to 20 ft. Choose OK.

C. Make sure the Theme is active. Go to **Theme** menu, **Start Editing**. Notice a dashed box around the box of the selected Theme. This indicates that the Theme is ready to edit.  * You can only edit one Theme at a time.

Now you are ready to begin drawing "digitizing" polygons!

D. Change the scale to 1:5,000 and Pan to find a field to digitize.

<u>2. Choose "polygon" tool from pull-down edit button.</u>



A. Click the starting point with the left mouse button…move mouse to the next point and so on until you create a polygon the way you want it. Double click to complete the polygon. (This snaps the vertices together at the end point) (Figure 3.8).

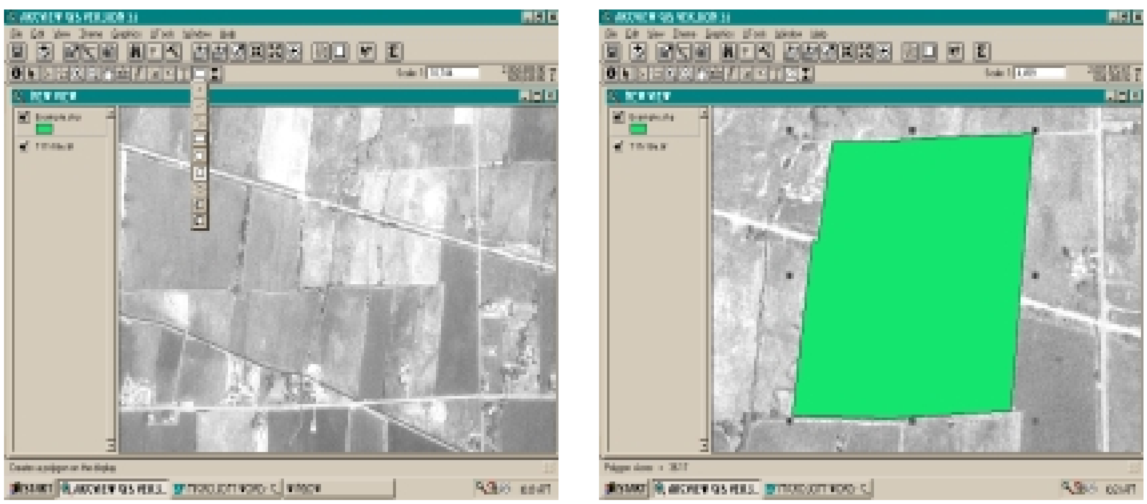


Figure 3.8

B. If you want the polygon to be "transparent" to be able to see the photo underneath, simply go into Legend Editor. Click "Paintbrush" icon, select the x from the upper left corner. This is the transparent color box.

C. **To make more curved polygons, add more vertices.**

D. Once a polygon has been completed, a "Record) will show up in the database. Enter the data for that feature (polygon) now by clicking "Open Theme Table" button. Make sure “Start Editing” is selected. Add the data. For example, if you are using FSA aerial photos, enter the tract number given on the photo. *(Figure 3.9).*

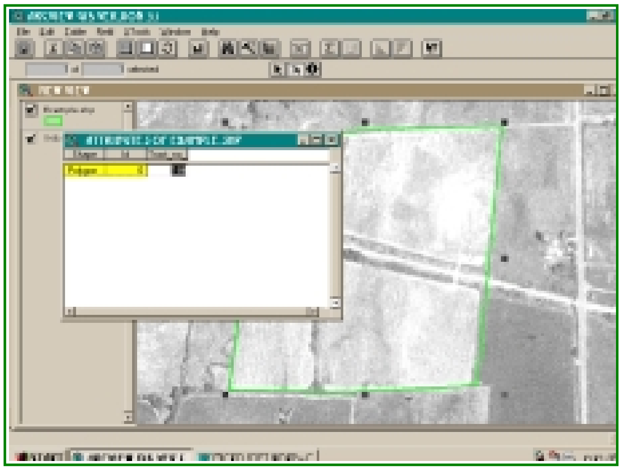


Figure 3.9

E. Save edits.

Note: It’s best to enter data as each polygon/feature is completed. By waiting to do a block of features you leave room for more error in data entry.

* Area and Perimeter will not be calculated until you tell Arc View to do so. Go to *XTools* menu item (see Appendix), select *Update Area, Perimeter, Acres, and Length*. An “Area”, “Perimeter”, and “Acres” field will be created with the known measurements.

Exercise 4 Editing Polygons

In most cases, instead of creating new data, you can use existing digital data and manipulate it to meet your needs. For example, you can update land use data by splitting parcels and entering new information into the database.

1. Turn on the extension “XTools”.

Go **to File** menu, **Extensions** and click on “XTools” at the bottom. Click OK. Now you have tools for updating acres. (Other tools are covered in “Phase II, Advanced training).

2. Use the “Auto Complete” tool button to add polygons to existing polygons.

A. Select the “Auto Complete” button  and begin the first vertex by overshooting an existing boundary and overshoot the final vertex *(Figure 3.10)*.. Double click to complete the polygon. The vertices will snap together at the existing boundaries. Therefore, there will be no overlap (*Figure 3.11).*

B. Calculate acres: Clear selected polygons. Go to **Xtools** menu, select **Update Area, Perimeter, Acres & Length.** Select “Theme1”. Click OK. Open the Table and notice the acres.

> **Note:** When digitizing large polygons/features, it may be easier to build a sequence of polygons that encompass the entire area, then use *Union Features* in *File* menu to make the polygon one. To do this select all the polygons holding down the *Shift* button, click *Union Features.*

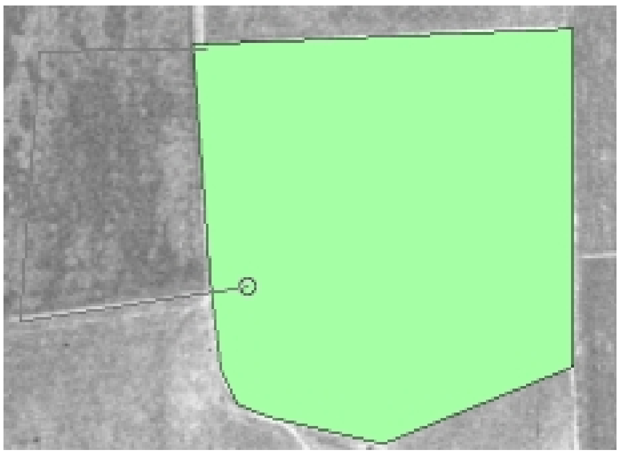


Figure 3.10

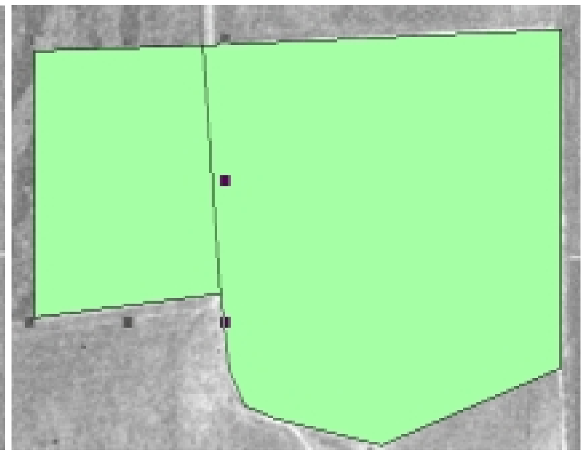


Figure 3.11

2. Use the “Split” tool to divide a polygon in half.

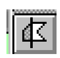
A. Click on the “Split” tool  Draw a line across a polygon. Make sure to ‘overshoot’ *(Figure 3.12)*. Double click to snap the vertices.

Figure 3.12

B. Open the Table. Notice the area and perimeter has been recalculated but the acres have not. Simply update acres in *XTools* menu and new calculations are done.

3. Edit existing vertices

A. Use the “Vertex Edit” tool  and select the vertex you want to move. Move the cross hair onto the vertex and drag the mouse to its new location. (Figure 3.13).

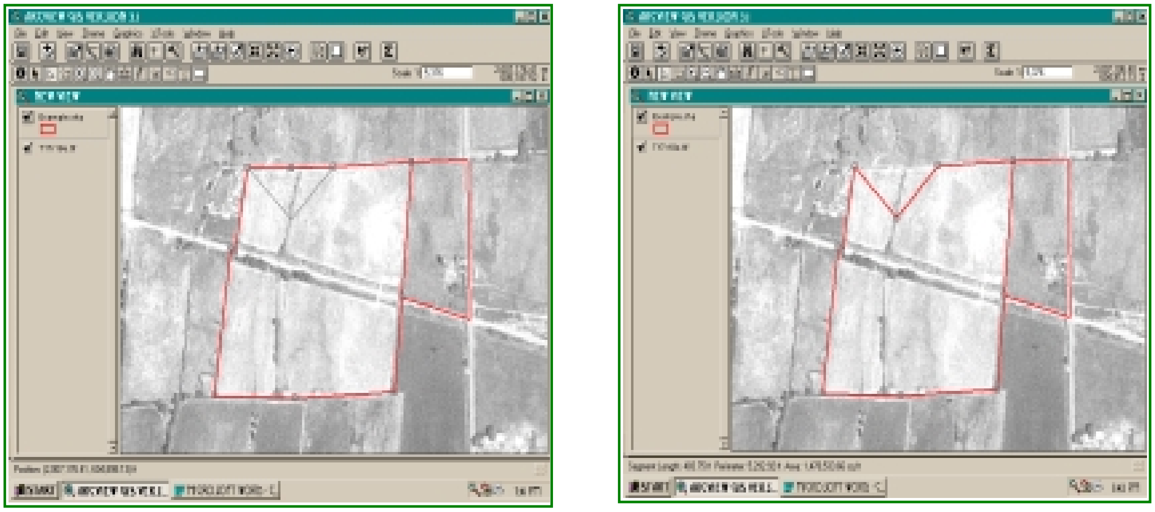


Figure 3.13

B. If the vertex is sharing a boundary and you want to edit it, first deselect the polygon(s) by clicking outside of the shapes. Next, place the cursor over the vertex until you see a white arrow. Click and notice that the end points of that segment of the polygon are ‘circles’. Now you can move any vertex within the two end points (circles). Moving the vertex will move any connecting boundary lines. *(Figure 3.14.)*

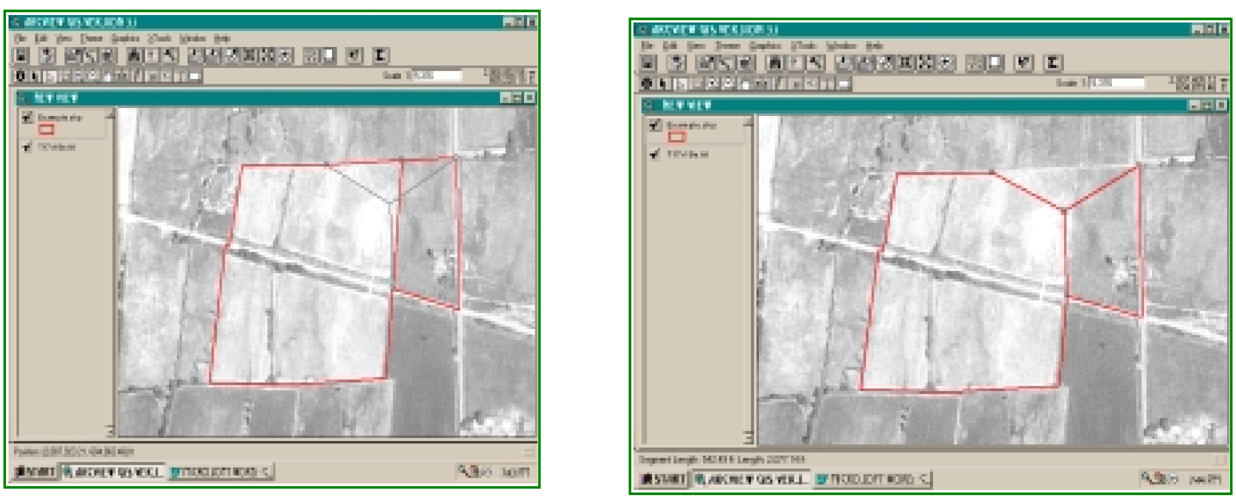


Figure 3.14

4. **<u>Save edits and save the Project.</u>**

3.2 Digitizing Using Digital Raster Graphics

DRGs are scanned quad maps that can be used to digitize features such as rivers, streams, contours, and roads. They are in an image format. Follow the same procedure used when digitizing from orthophotos.

You can also overlay them onto orthophotos by making the background of the DRG "transparent".

Exercise 1 Digitizing Line Features From DRGs and setting the Background to Transparent

1. Make a new View in proj4.apr. and call it "DRG Map".

Add "kittitas_15.tif" and "t17r19e.tif" located in *c:\gistemp\data.* Both are image files so remember to change the file type to "Image Data Source". Make sure "t17r19e.tif" is at the bottom.

2. Zoom into an area until you can identify features such as roads or streams (1:10,000).

3. Create a new "Line" Theme.

Go to **View menu-New Theme**. Select "line" Theme. Save as the default name.

4. Set General Snapping Tolerance to 50 ft.

5. Digitize a chosen feature by drawing a line on top of the existing line.

To digitize line Themes, use the line drawing tool .

6. Continue digitizing line segments using the line tool.

Try splitting a line by using the Split Line tool  . Note that this tool has limitations. It won't snap to the nearest vertex line it would using the split polygon tool.

7. Make the background of the DRG transparent.

A. Double click the Theme "ekitits.tif". The dialog box in *Figure 3.15* will appear. Click the "Color Map" tab to get the dialog box in *Figure 3.16*.

B. Double click the "white" color box and make it transparent *(Figure 3.17*). Click "Apply".

Figure 3.15

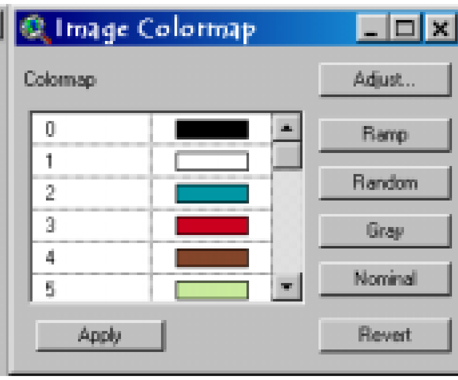


Figure 3.16

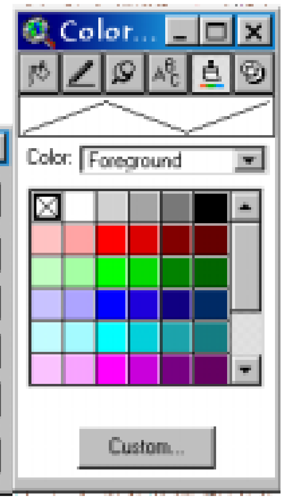


Figure 3.17

C. Notice the results. This is beneficial if you want to show contour lines on an orthophoto.

<u>8. Save edits and save the Project. You will use this Project for Section 4.</u>

4.1 Conservation District Applications

This section covers some of the ways in which Arc View is used in Conservation District work. Doubtless there are many other ways in which Arc View can be used to facilitate reporting, display progress, and show relationships spatially for Districts, and eventually we hope to incorporate them into this manual. If you or your District develop a new way of utilizing Arc View, and you think it might be useful to other Districts, please let us know. We are always seeking ways to make the most of Arc View's capabilities.

GIS Applications Useful for Soil Conservation and Water Quality Control:

- **Soil Loss/Water Quality Simulation with GIS:**
  GIS mapping helps quantify various field, soil, and runoff characteristics useful in calculating watershed yields of sediment, fertilizers and flows to specific stream reaches.

- **Watershed Planning:**
  Wetlands maps, riparian shade, fishery habitats, recreation, logging and other various activity maps can be derived using GIS.

- **Use of Crop Mapping to Target BMPs:**
  Crop pattern maps can be particularly useful to locate types of crops with high sediment yield, i.e. row crops and encourage those growers to use erosion control practices such as PAM application. Irrigation methods can also be tracked and analyzed for BMPs.

- **Dairy Nutrient Management Planning:**
  GIS ties to water pollution control planning for various kinds of confined animal feeding operations (CAFOs). Maps are useful in assessing runoff volumes and drainage patterns as well as sizing/locating containment ponds. Feed lot or dairy facilities can be superimposed over environmental factors such as soils, slope ,and riparian areas to produce more comprehensive analysis of impacts of CAFOs facilities/operations.

- **Farm Maps for Conservation Plans**:
  Farm tracts, fields, waterways, farm structures, irrigation systems, ponds, wells, and other features can be superimposed over aerial photography, soil survey data, etc. Critical areas can be identified such as wetlands, riparian buffers, erosion prone areas, high permeability and other areas of special concern. These resources and constraints can be better visualized with the accuracy and detail of a GIS.

- **Presentation and Reports:**
  GIS is used to produce professional quality output maps, charts and tables for use in reporting, information/education workshops, fair booths, and other forums. Conservation approaches, problem identification, successful solutions and resources/constraint maps can all be enhanced to show analytical factors important to that map/report.

Getting Set Up:

Data Needed:
DOQs of area
FSA Common Land Unit (CLU) (aerial photos hard copy maps)
image file of township and range (for State Plane coord. system), file of quads (for UTM coord. system)
county boundary shapefile
PLS shapefile (sections)

Planning Procedure:

Decide where to start. Do you want to begin digitizing the entire agricultural area in the county or create data as needed. Envision how this project will be built. It really matters if you are building field layers for a large area. If you are working in State Plane coordinate system, which township and range file do you want to begin with? If you are working in UTM, what quad file do you want to begin with?

When digitizing on an orthophoto, become familiar with existing features such as treetops, streams, roads, etc. Use the "measuring" tool to see how wide features are. You will be doing photo interpretation constantly to determine the most accurate placement of boundary lines.

Key Aspects of GIS Project Planning:

1. Think ahead to how the GIS will be used, but keep in mind what sources are available.

Designing an effective GIS involves setting clear goals. The temptation is to rush ahead and begin digitizing and converting data without establishing how the system will be used. Even for small GIS projects, it is wise to engage in a modest functional requirements study. This allows the user to gain an idea of exactly what data sources are required, how they will be processed, and what final products are expected. Without clear-cut goals, there is too great a danger that a project will omit key features or include some that are irrelevant to the final use.

2. Exert special care in designing and creating the database.

Again, it is easy to rush ahead with the creation of a database, and then find later that it has to be reorganized or altered extensively. It is far more economical to get things right the first time. This means that the researcher should chart out exactly how the database is to be organized and to what levels of accuracy and precision. Attention to (and testing) of symbolization and generalization will also pay off handsomely.

3. Always develop a prototype or sample database to test the key features of the system.

No matter the size of a project, the researcher should aim to create a prototype first before moving toward full implementation of a GIS. This allows the researcher move through all of the steps of creating and using the system to see that all procedures and algorithms work as expected. The prototype can be a small area or may be confined to one or two of the most critical layers. In either case, testing a prototype is one step that should not be overlooked.

4.1 Conservation District Applications – Farm Plan Map

Exercise 1 Making a Farm Plan Map

In these exercises you will use existing field data, roads, and waterways to create a farm plan for a producer.

1. Create a new View and name it "Farm Plan".

Add the following Themes located in *C:\GIStemp\farmplan*

Fields.shp
Roads.shp
Crep_Hydro.shp (see *Figure 4.1*)

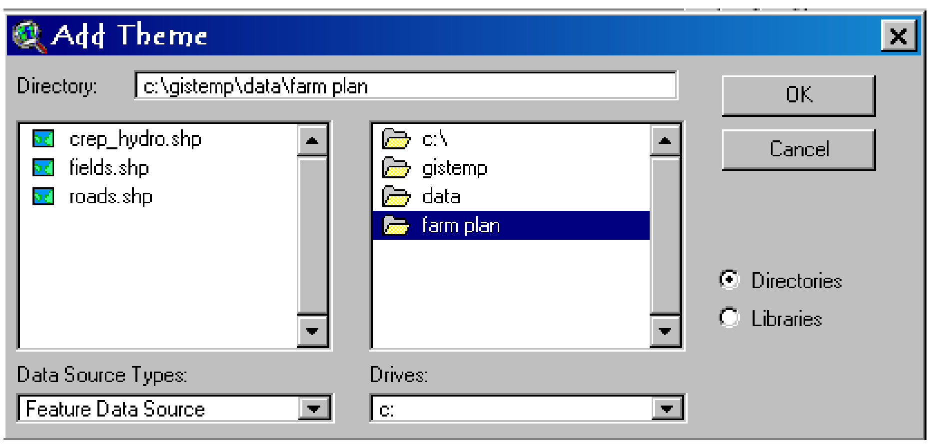


Figure 4.1

Add the aerial photo, T17r19e.tif . You must change the Data Source Type to "Image Data Source". Drag it to the bottom of the TOC. Zoom into the area where "fields.shp" is shown. Change the legend and order of the Themes to see them best (line width of 2 is good).

2. Make a map of John Doe's farm by selecting his fields.

Go to **Theme** menu, **Properties**. The 'Definition' icon should be highlighted. Click the "Query Builder" button. Give the expression*: ([Tract_]=540)]*. Click OK *(see Figure 4.2).*

Your results should look like *Figure 4.2*. Only the selected features show. Remember, to see the whole Theme, you must 'clear' your query in **Theme-Properties** .

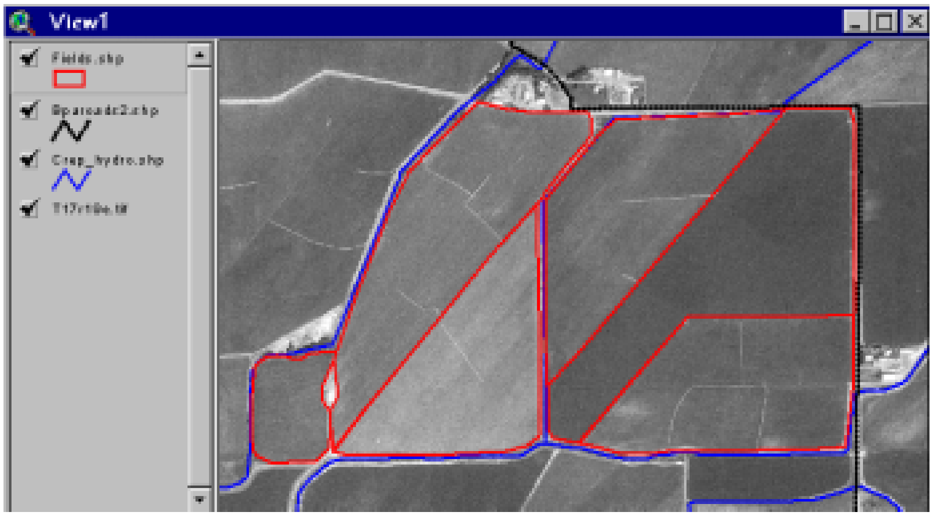


Figure 4.2

3. Add labels for field acres.

Make "fields.shp" the active Theme. Go to **Theme-Properties, Label** icon, Field Type is "Acres" (*Figure 4.4).* Click OK.

Figure 4.4

A. Click Label button  Click on the fields. You can move (drag) the label once it is placed.

4. Add road names.

Make "Roads.shp" the active Theme. Go to **Theme-Properties**, **Label** icon, Field Type is "Road_name". Click OK. Click Label button  Click on the roads.

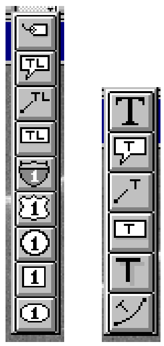
5. Add waterways.

Make "crep_hydro.shp" the active Theme. Go to **Theme-Properties**, **Label** icon, Field Type is "Name". Click OK. Click Label button  Click on the waterways.

6. Adjust the size and look of the labels if necessary.

You can go to Edit menu, Select All Graphics and make the font size smaller. Remember there are other labeling tools available as shown below. Save changes and close this Project.

> **Note:** The default size for text is 14. If you want a different size, set it in the Symbol Window (Ctrl P) first. There is an option to change default settings of labels, text, borders, etc. under **Graphics** menu, **Text and Label Defaults**, but this will change settings for the entire Project, not just one View.



6. Your map should look similar to the one in *Figure 4.5*.

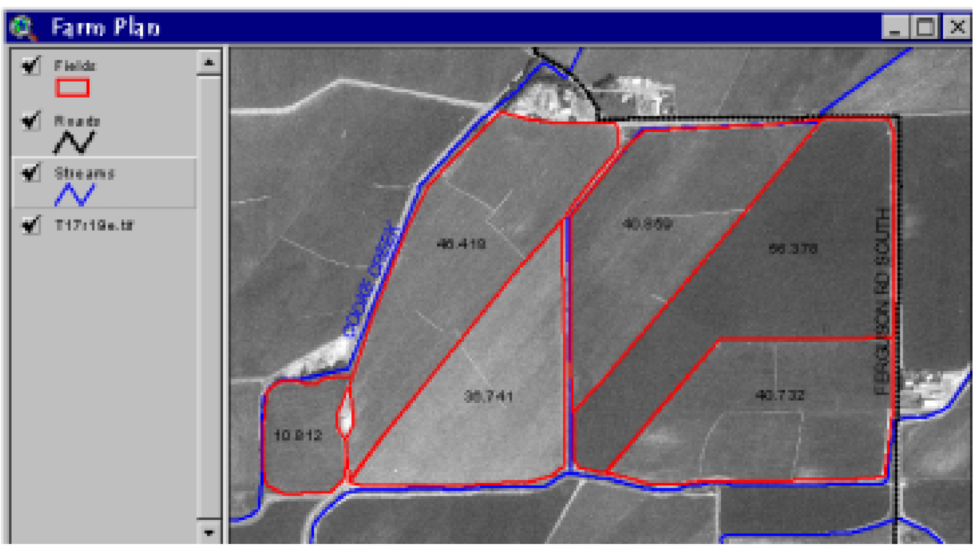


Figure 4.5

4.2 Working with Soils Data

Exercise 2 Analysis of Soils Data

In this exercise you will use the soils Theme to select the high percent slopes, high kfactor (erosion potential) and then map the results. You will use one Theme to get two results: slope and kfactor Themes.

1. Create a new View in your Project and name it "Soils".

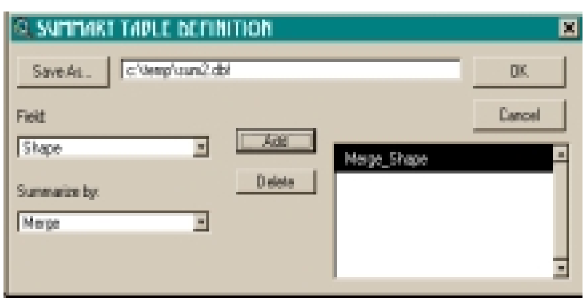
Add the Theme "kfact.shp" located in *C:\gistemp\data\soils* and turn it on

2. Group the "like" soil unit values.

Currently there are 182 soil units. By summarizing the table, you will simplify the number of soil units or records to 38.

A. Open the Theme table. Highlight "Soil Unit" field. Go to **Field** menu, select **Summarize.** Select the choices as shown in Figure 4.6.

B. B. Select Fields "Kfactor" and "Slope." Summarize by "Average." Click Add, then select OK as shown in Figure 4.7.



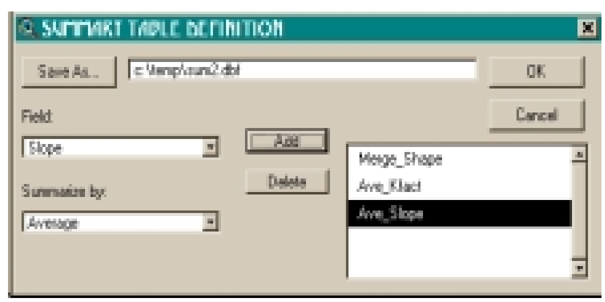


Figure 4.6 **Figure 4.7**

A new Theme and table are created. Add it to the View. Look at the new table. Notice the number of records has decreased to 38 records. Tile the windows to compare differences. (**Window** menu – **Tile**). Now this theme will be easier to work with.

2. Find the slope which is greater than 38%.

A. Go to the Legend Editor and set the legend type to "Graduated Color". See *Figure 4.8*.

1. Set Classification Field to "Slope".

2. Normalize by “None”.
3. Classify by “3”.
4. Set Values as demonstrated in *Figure 4.6*. Set Color Ramp. Select “Apply.”

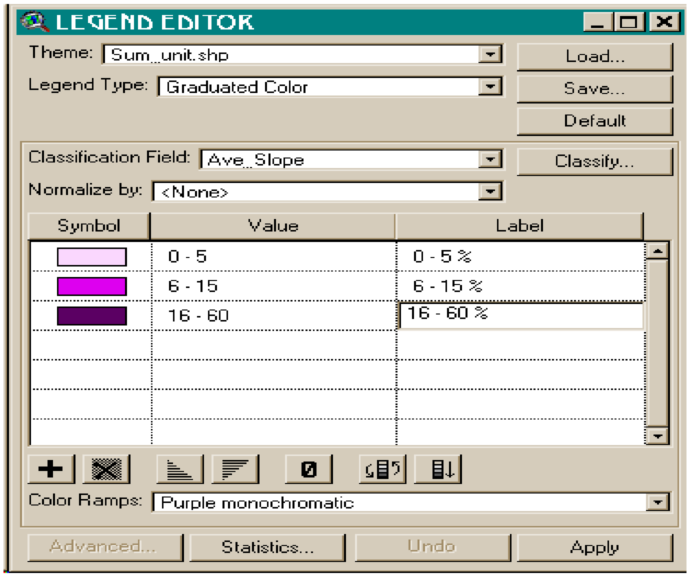


Figure 4.8

B. Go to **Theme** menu, choose **Properties,** click “Query Builder” tool. Give it expression: (Slope] > 38). Only those selected records should appear (*Figure 4.9).*

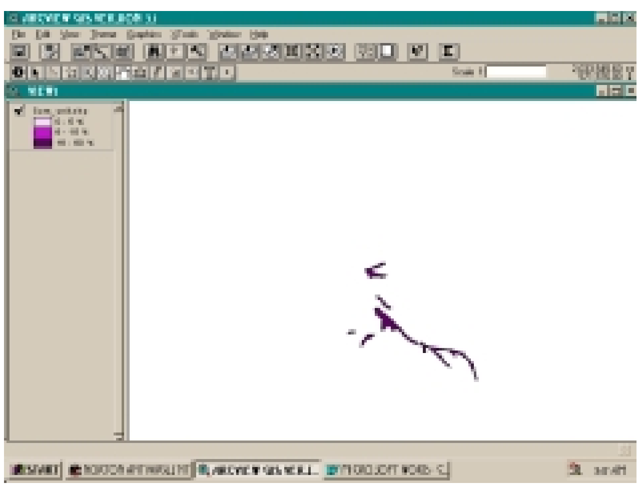


Figure 4.9

5. Save the legend and convert this Theme to a new shapefile.

A. Go back into Legend Editor, save the legend by clicking the “Save” button. Name it “slope.avl”, then click “Default”. The legend is back to “Single Symbol”.

B. Go to **Theme** menu, choose **Convert to Shapefile**, name the file "highslope.shp" then add it to the View. Make it a color that stands out like red.

C. Make the "sum1.shp" Theme active, go back into **Theme-Properties** and 'Clear' the query. Click OK. The View should look like it did before the query.

<u>6. Go through the same process as in exercises 4 to set up the kfactor field</u>.

A. Go to **Theme - Properties** and change the name of the Theme to "kfactor".

B. This time you will set your legend type to "Graduated Color" and set the Classification Field to "kfactor". Classify by "4". Set values as shown below:
0 - .21
.22 - .36
.37 - .42
.43 - .60

C. You should get the following View once you move the "kfactor" Theme below "highslope" *(Figure 4.10).*

D.

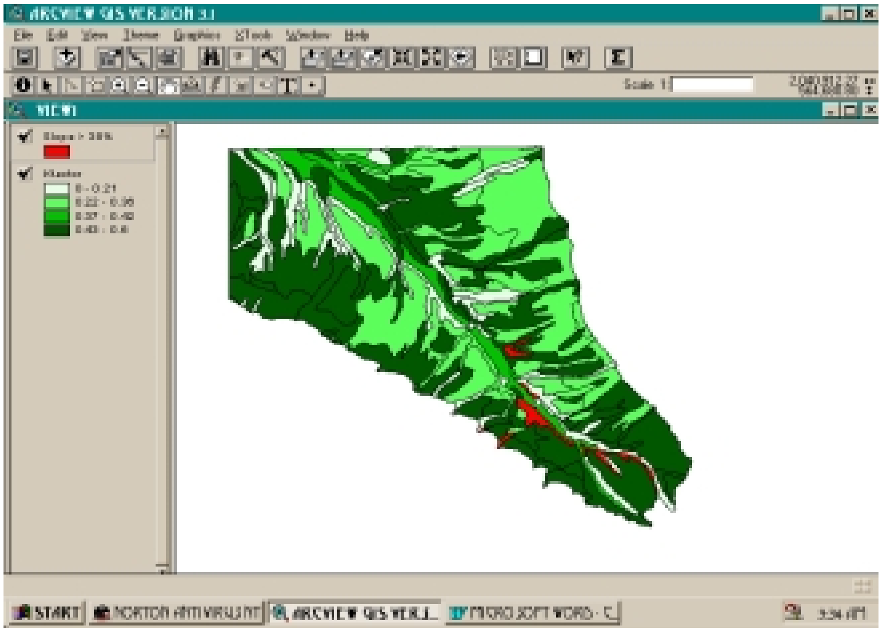


Figure 4.10

4.3 Working with Dairy Data – Part 1

Exercise 3 Dairy Density Selection and Clipping

The Data used in this exercise is courtesy of Sharon O'Connor, DOE, Olympia. She obtained the dairy data from the EPA website: *http://www.epa.gov/r10earth/offices/oea/oea.html*. (This data may be outdated, but serves our purpose for this exercise).

1. Create a new View in your project and name it "Dairy Density".

Add the following Themes located in *C:\gistemp\data\dairy:*

County.shp
Cities.shp
Rivers.shp
Marine.shp
Dairies. .shp
303dstreams.shp

Change the appearance of the Themes to your liking. Also remove the .shp from the Theme names (in **Theme-Properties**).

In this exercise you will pick an area with a high density of dairies, create a new shapefile and use the "Select by Theme" and "Clipping" methods to select only the dairies in that area.

2. Create a new polygon shapefile. Call it "cowbdry"

Draw a box around a densely populated area of dairies. Stop editing. Change the appearance of your new Theme in the Palette Manager to make it transparent.

3. Select only the dairies within "cowbdry"

Go to **Theme** menu, **Select by Theme**. Make "dairy farms" the active Theme. Select features of the active Theme that *intersect* the selected features of "cowbdry" *(Figure 4.11)* Notice that all of the selected dairies are in yellow and the records are also selected (*Figure 4.12).*

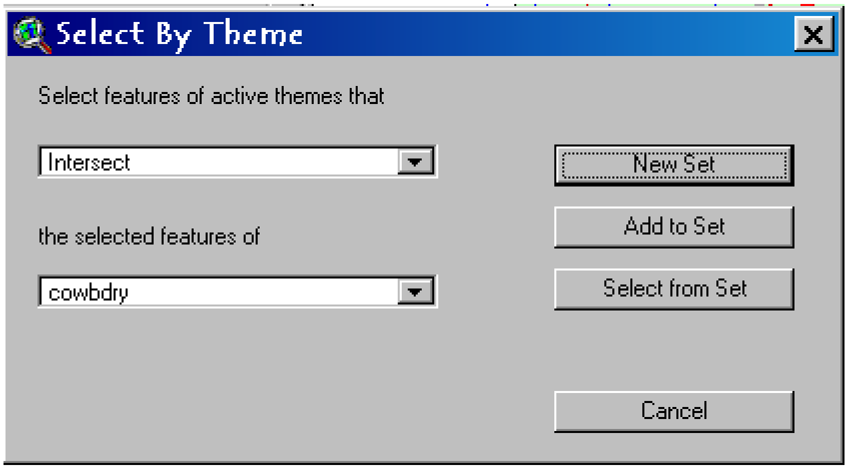


Figure 4.11

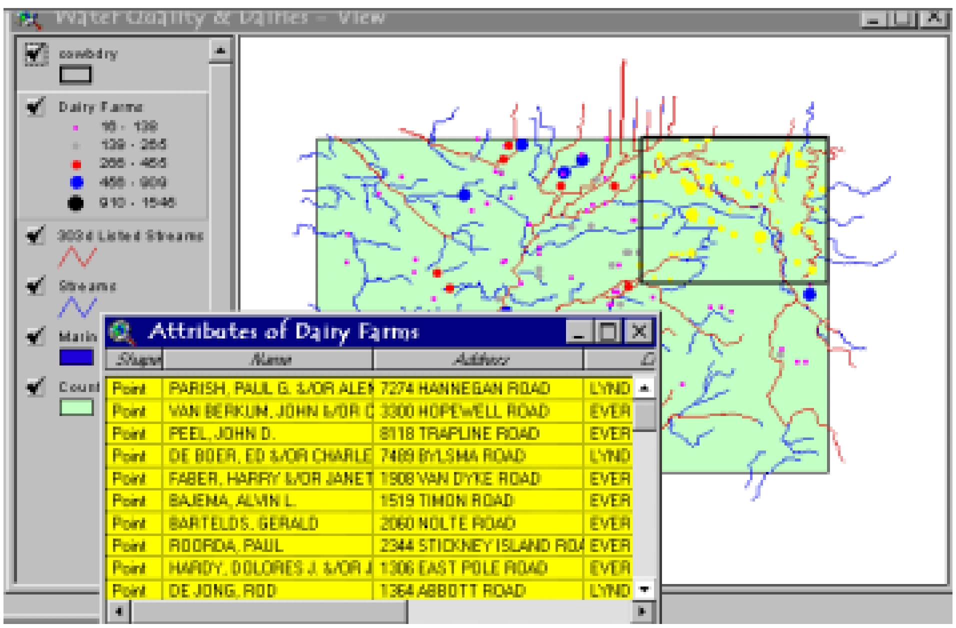


Figure 4.12

4. Open the Table, and click the *Promote* button.

Notice the number of records selected. Now you can do analysis on the selected dairies. Clear selected features before continuing.

5. Make a new Theme of just the dairies within "cowbdry."

There are two ways to do this:

1. (easiest and fastest) Go to **Theme** menu, select **Convert to Shapefile**. Name the new Theme "sel_farms.shp"

2. (more steps) Use the Geoprocessing Wizard extension to clip the selected features and make a new Theme.

   Make sure it is active by going into File menu, Extensions and checking "Geoprocessing". Click OK. Go to **View** menu, click **Geoprocessing Wizard**, click "Clip". Notice what the Clip feature does *(Figure 4.13)*, then "Next". Select "Input Theme to Clip" as "Dairy Farms" and the "Polygon Overlay Theme" as "Cowbdry". Name it "clip_cow" and save it to your working directory, then click next. Arc View will create a new Theme and add it to your Table of Contents.

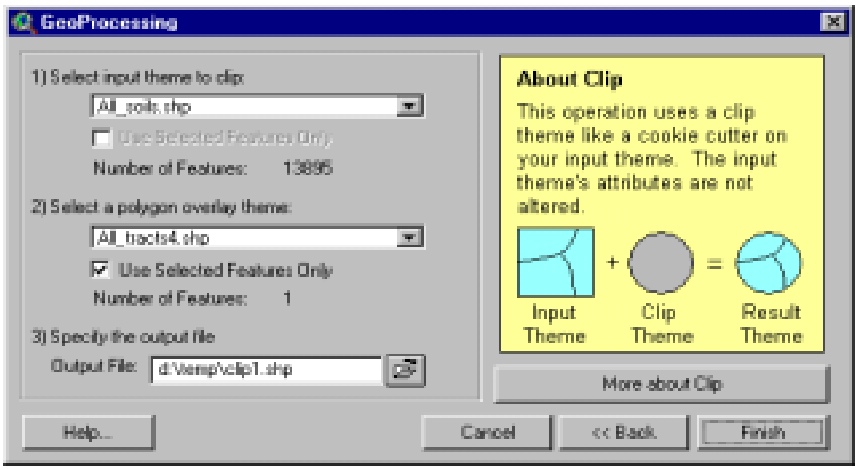


Figure 4.13

6. Close the View and save changes.

4.4 Working with Dairy Data – Part 2

Exercise 4 Finding Water Quality High Risk Areas Near Dairies

In this exercise we are going to perform a spatial location analysis. We are interested in finding dairies that meet the following criteria:

- Within 3,000 feet of a city boundary
- Within 300 feet of a 303d stream
- A cow population of 150 or greater

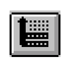
In order to do this we will need to perform three different queries and save the results.

1. Open a new View and call it, "Water Quality Potential Risk Areas." Set your map and distance units to feet.

Copy all of the Themes from the "**Dairy Density**" View into your new View.

2. Where "Dairies" is the active Theme, find Dairies that are within 3,000 feet of a City boundary.

Go to **Theme** menu, choose **Select by Theme**: "Active Theme is within 3,000 ft. of "Cities." Choose *New Set*.

Click the promote button to bring the selected set to the top. 

Now open the Theme table for "Dairies". Go to **Table – Start Editing** and **Edit – Add Field.** Make the new field a Boolean type and call it "CityDist". (*Figure 4.14*)

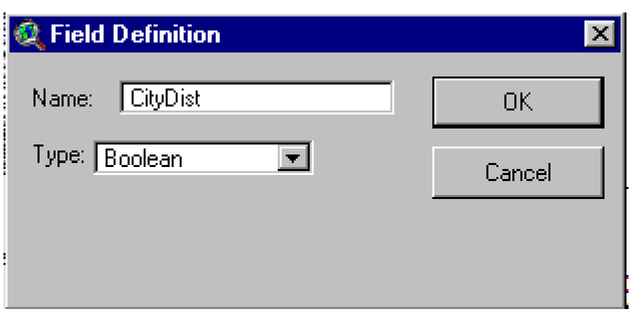
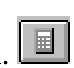


Figure 4.14

Note: a Boolean field is a way of preserving queries permanently by assigning a "true" or "false" value to the results of your query (spatial or tablular).

Create two more Boolean fields and call them "303Dist" and "Cow".

Make the "CityDist" field active and click on the **Field Calculator** button. 

You will see the following dialog box: (*Figure 4.15)*.

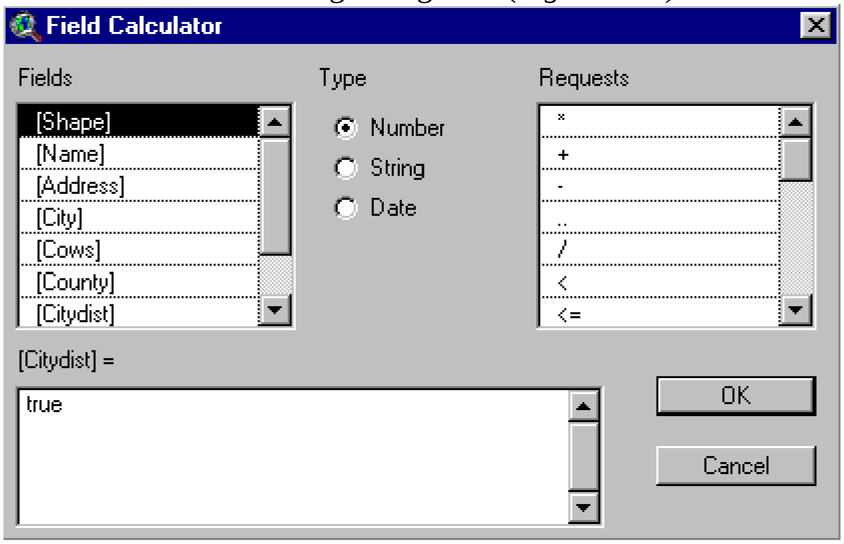
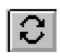


Figure 4.15

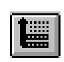
All you need to do is type in “true” in the lower part of the dialog box .
Click OK and go to your Theme table.

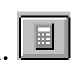
Click on the **Switch Selection** button. 

Now go through the same process as before except type in “false”.

<u>2. Where “Dairies” is the active theme, find Dairy Farms that are within 300 feet of a 303d Listed Stream.</u>

Go to **Theme** menu, **Select by Theme**: “Active theme is within 300 feet of ‘303d Listed Streams’.” Choose *New Set*.

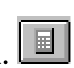
Click the promote button to bring the selected set to the top. 

Make the “303Dist” field active and click on the Field Calculator button. 
Go through the same steps as before.

Next, click the Query Builder button . 

Query the Dairies theme with the following expression:

([Cows] >= 150)

Make the “Cow” field active and click on the Field Calculator button. 
Go through the same steps as in the previous queries.

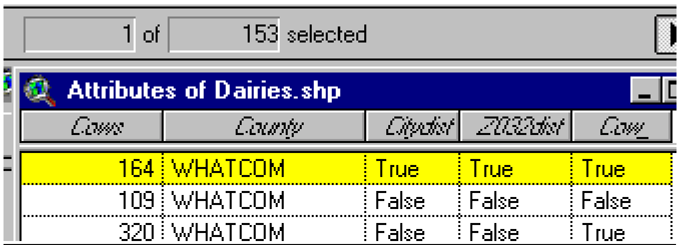
Now you are ready to perform the final query.

Click the Query Builder button. 

Enter the following expression exactly as it appears:

([Citydist]) and ([303dist]) and ([Cows])

Your result should show one record that meets all of the criteria (*Figure 4.16 and Figure 4.17*).



1 of 153 selected

Attributes of Dairies.shp

Cows	County	Citydist	2032dist	Cow_
164	WHATCOM	True	True	True
109	WHATCOM	False	False	False
320	WHATCOM	False	False	True

Figure 4.16

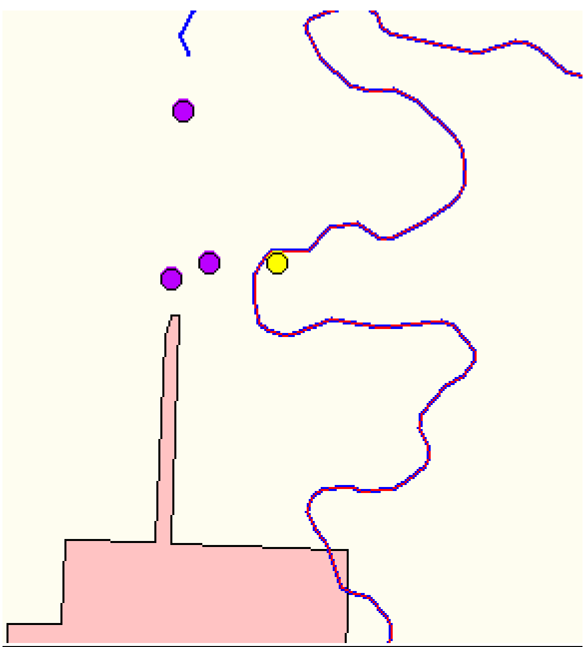


Figure 4.17

Troubleshooting Tips

Deleting, Renaming and Copying shp files

The best way to do this is in ArcView, not in "My Computer" or "Windows Explorer". Go to the File menu in a View, then to "Manage Data Sources". Find the file, then click "copy", "rename", or "delete" and follow instructions given. "Cancel" when done. ArcView *knows* to get all files associated with the shp file. By performing these functions in "My Computer" or "Explorer", you leave room for error and possible corruption of Projects and shp files.

Moving Projects

If your project contains many different themes and views it may be easier to use an extension and script to move it. Remember, ArcView creates many different file associations in projects. If you just move a project and copy the shape files you will have to go through the arduous and sometimes painful process of project repair. In order to avoid this use the following scripts and extensions. Both of these were obtained from the ESRI Avenue Scripts section of the ESRI Webpage which can be accessed at **www.esri.com**.

Project File Organizer Extension - AVApr.avx

This ArcView extension runs under Windows 95/NT operating system. It will add a new menu item to the ArcView's File Menu. The user can use this extension to organize and distribute the ArcView Project (.apr) files and their data files. The extension will copy the Apr file to any new file locations, it will search for all data files associated with the Apr file
and copy them to the same location.

There are three files included with the extension:

1. Readme.txt
2. AVApr.avx - ArcView extension file
3. AVDlls.dll - Visual C++ File

To install this extension to your system, do the following:

1. Create a new folder named DDE under C:;
2. Place AVDlls.dll file in the DDE folder; and
3. Place AVApr.avx file in ArcView's Ext32 folder.

To use this extension, first open the project file in ArcView, activate the "Project File Organizer" extension, select the new menu item "Transfer Project File" from the File Menu, and define the new file location. This extension will copy the project file and all its data and map files to the new location.

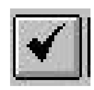
To put a project file in a CD, first create a new folder under the root drive (C:\ or D:\ or F:\) or map a new drive to the new folder, then use this extension to copy the project file to the new folder. When completed, copy the entire folder to CD.

When you have completed project file organizer process you need to run the changepath script written by Marc Hoogerwerf. This changepath script searches for the path references in an apr and removes the directory part thus enabling you to avoid the project repair process.

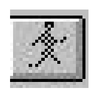
To use the changepath script open a new script in the ArcView Scripts project window.
Click the load text file button.

Navigate to where the changepath.ave file is and open it.

Now you need to compile the script using the compile button.



After you have compiled the script the run button will be enabled.
Click the Run button and proceed with the process.



Remember to run the Project File Organizer first to move the project to its final destination. When you have all the files moved run changepath to change the file associations.

Important notes on Tables/dbf files

⇒ It is a good idea to delete all "Attributes of" .dbf files in the **Project** window before exiting ArcView. The files are "virtual" files and only provide links in the Projects. You won't "hurt" anything by doing this. The reason for this is because for unknown reasons, if you are editing a table and want to enter data, sometimes ArcView won't let you if you have too many "attributes of" files open at once. Once these are deleted or closed out, then you can enter data in the table you are working in.

⇒ ***Never** delete ".dbf files". (You can remove them from the Project window, but never delete them from the hard drive, unless you want to delete all components of the shapefile, then go to "Manage Data Sources" to do this properly). .dbf or dBASE files are linked to the shapefiles on your hard drive. If you delete these files ArcView will not have a database to link to in the Project and the Project may become corrupted.

⇒ For all intensive purposes, edit tables (data only) in ArcView. If you want to change the "look" of the table you can

1. export tables to MS Excel or Access (a new file will be created). See ArcView GIS, page 234.
2. Open a .dbf file in Excel. Choose "All" file types. Be sure to "Save Table As" a different name in case the table gets corrupted. Then you will always have the original dbf necessary to use in ArcView.

⇒ To add tabular data containing x,y coordinates to a map, 1st make sure the table is saved in dBASE IV format. Then bring it into ArcView (see ArcView GIS, page 70 & 71). Note that it is viewable , but to permanently save it, always "Convert to Shapefile". Note this only works for point data.

⇒ To export a map (in View or Layout): see ArcView GIS, page 237.

Tips on Views

⇒ You can save customized legends in **Legend Editor**. Go to "Save" in Legend Editor. To retrieve that legend file go to "Load".

⇒ To get a transparent fill pattern in legend, go to Palette Manager icon in the symbol window. Click "Load". Go to C:\esri\av_gis\arcview\symbols. Choose "hatch.avp". Save as default setting by clicking "Default" button. Now go to *spilled paint can* (hatch mark palette). Scroll down the hatch patterns until you get to the ones that are in bright green. These are the hatch marks that can be set to 'transparent'. Go to color palette and set the background to transparent (by clicking the 'x' box). Fill will be whatever hatch pattern looks best. Experiment with this.

⇒ If you want additional colors or other symbols, go to the Palette Manager and go through same steps as above.

Tips on Projects

⇒ If many problems occur in your Project, it is probably corrupt. Try the following:

1. Rename Project
2. Copy Themes in Views to a new Project (if you can get to them)
3. If that doesn't work, call tech support
4. Make new Project and start over

To limit chances of corrupting Projects, shp files, dbf files, etc., keep Projects small (under 10 Views per Project). You can have many Projects. The more Views and Layouts you have in the Project, the longer it takes to load, and more chance of unrecoverable error (corrupt Project = Start Over!

Tips on Layouts

⇒ When making Layouts, put a neat line around all the objects in the Layout. This helps keep maps (all objects in the Layout) from being "cut off" along the edges when printing. (This mainly applies when using a plotter and ArcPress to print aerial photos). Call Nicole if you have any questions about this.

⇒ Use the Legend Wizard to make more defined legends.

⇒ You can save layouts that you have created in Template form. To store a layout as a template first make the project window active.

- Double-click the Layout icon to make a new, empty layout document. Make sure that the page orientation and size is that same as the layout you want to save.

- Go back to the layout you want to save. From the Edit menu, choose Select All. All elements on your layout are now selected. On your keyboard , press Cntrl+C to copy all of the elements.

- Go to the new layout and press Cntrl+V to paste the elements onto the new layout.

- Double-click the inset view frame. In the View Frame dialog box select <Empty View>. Do the same for any other views.

- From the Layout menu choose Store As Template. Choose an appropriate name for the template and select an icon for it. Click OK. This writes out a file called template.def to your HOME directory.

- Save and close the project.

More Useful Web Sites:

http://www.esri.com

ArcView Scripts Download: http://andes.esri.com/arcscripts.cfm

ArcView Knowledge Base (searchable archive of problems
answered by subscribers to ArcView-L)
http://www.gfi-gis.com/en/services/avkb/default.htm

EPA Region 10 Download

http://www.epa.gov/r10earth/datalib/

⇒ Periodically delete "delta" files from the c:\"temp" directory. These "delta" files are created through ArcView but are unnecessary to leave in the hard drive and take up extra space.

Importing Arc/Info Coverages

⇒ How to import Arc/Info coverages:
Go to "Start Menu" > Program Files > "ESRI" > "Import 71"
In the dialog box use the *Browser* to find the path of the file (usually an "e00" extension) Then give a new name and path for the imported file. You will be able to bring this file into a View in ArcView, but you need to convert to a shape file before any manipulation of data can occur.

Understanding What "World" Files Are

The image world file is an ASCII text file (an acronym for American Standard Code for Information Interchange; a widely used binary code for storing and transferring data) that provides georeferencing information to the image theme. With it, your image theme will display coordinates and will be oriented with other themes in your view. Without it, your image theme will display only pixel coordinates in the view which will not coincide with other themes in your view.

World File Extensions:

World files can be different 3-character file extensions depending on what program they were created in and their intended use. The file may need to be renamed to an extension that ArcView recognizes. A world file is associated with an image by the following naming convection: if the image file name has a 3-character extension (e.g., image1**.tif,** image2.**bil**), the world file has the same name followed by an extension containing the first and last letters of the image's extension and ending with a "w" (e.g., image1.tfw, image2.blw).

To Rename world files:

Go to **My Computer** or **Windows Explorer** on the desktop. Navigate to the subdirectory where the image and world file are located. Click the file that is 1 KB (the world file). Rename the extension of the file and click "OK". Accept the changes by saying "yes" to the question.

Summary of contents of world files:

X-dimension (width) of a pixel in ground units
Rotation terms

Rotation terms
Y-dimension (height) of a pixel in ground units
X-coordinate of center of upper left pixel
Y-coordinate of center of upper left pixel

Accessing Frequently Used Data

To easily access your most frequently used data, set the working directory for the ArcView icon in Windows. To do this on Windows 95/Windows NT 4.0 and higher:

1 Create a shortcut to the arcview.exe. (Consult Windows Help for more information about creating a shortcut for an application.)
2 Select the Shortcut to arcview.exe icon, then choose the File-Properties option. Click on the Shortcut tab and enter the path to where you want ArcView to first look for data in the Start in field. Click OK.

Setup will set the working directory to the location where the quick start tutorial data (and, optionally, the map data) were installed. If you chose not to install any data, the working directory will be set to where ArcView installed.

Automatically create backup copy of a project when you open it

Here are a few lines of Avenue code that can be added to the ArcView system script, Project.Open. Adding this code will automatically create a backup of the project when you open it. To update Project.Open:
1 Copy the Project.Open script into a new, empty script
2 Insert these lines after the line: theFName = FileDialog.Show.....

```
strFullPath = theFName.GetFullName
strBakPath = strFullPath.Substitute (".apr", ".bak" )
File.Copy( strFullPath.AsFileName, strBakPath.AsFileName )
```

3 Replace the old version of Project.Open with the new.

Long file and directory names

Be careful when moving or creating data for use with ArcView. ArcView does not support long file names. These include file names that contain spaces or are long (greater than 8 characters) in the path directories or name of the data source.

ArcView's Environment Variables

AVBIN is an environment variable set in ArcView's startup script that references the binary directory in ArcView's installation directory. For UNIX, AVBIN simply references $AVHOME/bin. When you run ArcView in a 32 bit Windows environment (Windows NT or Windows 95), AVBIN references $AVHOME/bin32.

AVEXT is an environment variable set in ArcView's startup script that references the default ArcView extension directory. This directory contains the extension files (.avx) for ESRI's extension products - Spatial Analyst, Network Analyst, DBThemes, etc.. The extension files in the directories referenced by AVEXT and USEREXT appear in the extension dialog. If you want other extensions to appear in the extension dialog, you must move extension files to these directories or change the value of these environment variables with the system request SetEnvVar. For example, if you want to examine the extensions available in the samples directory through the extensions dialog, you might change USEREXT to $AVHOME/samples/ext with the following code.

```
system.SetEnvVar( "USEREXT", "$AVHOME/samples/ext".AsFileName.GetFullName)
```

For UNIX, AVEXT references the directory $AVHOME/ext. For Windows, when you use a 32 bit operating system (e.g. Windows NT or Windows 95), AVEXT references the directory $AVHOME/ext32.

AVHOME is ArcView's installation directory. The environment variable AVHOME is set by ArcView and is available for you to use in scripts within the ArcView application.

ArcView uses the HOME directory for your default working directory and the initial current directory.
If your have defined HOME through your operating system, ArcView uses that value. If you have not specified HOME, ArcView attempts to establish HOME in its startup script. ArcView looks for a writable directory searching for environment variables TEMP, CWD and AVHOME. If ArcView cannot find a writable directory in one of these three options, you will get a warning message when you start ArcView instructing you to define HOME.

During ArcView processes such as editing a table, creating a histogram, or printing a file, temporary files are generated. By default, these temporary files are stored in a temporary directory, /tmp on UNIX and temp (or tmp) on Windows. If the space in your temporary directory is less than needed, you may have problems.

TMPDIR is an optional environment variable you can set to redirect temporary files to a larger directory (where you have write access). On UNIX, you can set the TMPDIR variable in your .cshrc or .login file using:

setenv TMPDIR /<my_storage_directory>

On Windows NT, you can set TMPDIR using the Systems Properties Environment dialog. (Right-click the My Computer icon, then choose Properties.)

On Windows 95 you can set TMPDIR by adding the following line into the autoexec.bat file:

set TMPDIR=<drive_letter_of_your_choice>:\<my_storage_directory>

Note   It's a good idea to periodically check your personal temporary directory and delete temporary files your system didn't automatically delete for you.

USEREXT is an environment variable set in ArcView's startup script that references the default user extension directory. By default, USEREXT references your HOME directory. The extension files in the directories referenced by USEREXT and AVEXT appear in the extension dialog. If you want other extensions to appear in the extension dialog, you must move extension files to these directories or change the value of these environment variables with the system request SetEnvVar. For example, if you want to examine the extensions available in the samples directory through the extensions dialog, you might change USEREXT to $AVHOME/samples/ext with the following code.

```
system.SetEnvVar( "USEREXT", "$AVHOME/samples/ext".AsFileName.GetFullName)
```

Removing Avenue entries from ArcView's Help index

By default, ArcView's Help index includes entries for the classes, requests and enumerations in the Avenue programming language that's part of ArcView. In the Help index, these entries are proceeded by "(Class)", "(Request)" and "(Enumeration)" respectively. You can easily set up ArcView's Help so that these Avenue entries are not included in the Help index. Excluding these entries makes the index smaller and easier to browse through and is useful if you won't be using Avenue to customize ArcView or build applications, or if you are configuring ArcView for users who won't be.

When Avenue entries are excluded from ArcView's Help index, you can still access help about Avenue's classes and requests via the ArcView Class Hierarchy reference help topic. You can also still get help about an Avenue class, request or enumeration in an Avenue script by highlighting the term in your script and then pressing the Script Help button .

To remove Avenue entries from ArcView's Help index

1   Close ArcView's Help if it is currently open.

2 Look in ArcView's help directory/folder and open the file called arcview.cnt in a text editor such as Windows Notepad.

3 Delete the following lines that you'll find near the top of the file (not all these lines may be present):

:Index ArcView Classes=classes.hlp
:Index ArcView Database Access Classes=dbaccls.hlp
:Index ArcView Spatial Analyst Classes=spatcls.hlp

:Index ArcView Network Analyst Classes=netcls.hlp

(You may want to cut and paste these lines into a separate file so that you don't lose them completely).

4 Exit your text editor and save arcview.cnt

5 Start ArcView's Help (either by launching the arcview.hlp file in the help directory or by choosing Help Topics from ArcView's Help menu). When you choose the Index tab, you'll see that the Avenue entries have been excluded.

To put the Avenue entries back into ArcView's Help index, edit the arcview.cnt file again and put the lines that were taken out back in. Make sure they go immediately after the last :Index line near the top of the file.

List of file extensions related to ArcView

Platform: ALL
This list may not be exhaustive, but it is very extensive.

adf - ARC/INFO coverage data file
agf - Atlas GIS native binary geodataset file
ain - attribute index file
aih - attribute index file
apr - ArcView Project File (ODB format)
avl - legend template file (ODB format)
avp - palette file (ODB format)
ave - Avenue script
avx - ArcView extension file (ODB format)
ai - Adobe Illlustrator picture file
bat - DOS batch file
bil - image file (band interleaved by line)
bip - image file (band interleaved by pixel)
blw - world file for bil image
bmp - Windows bitmap image file
bpw - world file for bip or bmp images
bsq - image file (band sequential)

bqw - world file for bsq image
c - C programming language source code filename
cat - UNIX hyperhelp supporting file
cgm - Computer Graphics Metafile
cls - geocoding classification file
cnt - help file contents
dat - generic data file extension
dat - INFO attribute file
db - Object Database File (also ODB)
dbf - dBASE tabular data file
dbf - Shapefile attribute table file
dbg - problem debug log file
dcp - default codepage file
dct - geocoding dictionary file
dec - UNIX hyperhelp supporting file
def - defaults file (North Arrows, Layout Templates, etc) (ODB format)
dem - Digital Elevation Model file
dgn - Design drawing file (Intergraph)
dir - INFO directory manager file
dlg - Digital Line Graph file
dll - Windows Dynamic Link Library file
doc - MS-Word, MS-Wordpad document file
dtd - UNIX hyperhelp supporting file
dwg - Drawing file (AutoCAD)
dxf - Drawing exchange file
e00 - ARC/INFO export file
eps - Encapsulated PostScript
exe - DOS/Windows executable file
fbn - spatial index file for read-only datasets
fbx - spatial index file for read-only datasets
fls - Windows help supporting file
ftg - UNIX help supporting file
fts - UNIX help supporting file
gen - ARC/INFO UnGenerate format
gfw - world file for gif image
gif - image file (CompuServe)
hdr - header file (for ArcView extensions or TIF images)
hlp - Windows help file
htm - WWW file (hypertext markup, 3-character DOS version)
html- WWW file (hypertext markup language, UNIX version)
ico - Icon file
idx - geocoding index for read-only datasets
img - ERDAS Imagine image file
ini - initialization file
ixc - geocoding index for read-write coverages
ixs - geocoding index for read-write shapefiles
jpg - image file (Joint Photographic Experts Group)
key - geocoding matching keys (ODB format)
lin - ARC/INFO lineset symbol file
lnk - Windows shortcut icon link file
mat - geocoding matching parameters file
mcp - image file (MacPaint)

mid - MapInfo interchange format (always paired with "mif")
mif - MapInfo interchange format (always paired with "mid")
mrk - ARC/INFO markerset symbol file (not compatible w/ArcView)
mxc - geocoding index for read-write coverages (ODB format)
mxs - geocoding index for read-write shapefiles (ODB format)
nit - INFO table definitions file
ndx - fonts index file (UNIX only)
nls - Codepage language files
odb - Object Database ASCII file (ODB format)
pat - geocoding pattern recognition file
pdf - preferences definition file
pif - Windows program information file (for DOS programs)
pps - processing set codes
prj - projections definition file
ps - PostScript file
rlc - image file (run-length coding)
rs - image file (raster snapshot | Sun rasterfile)
sbn - spatial index for read-write shapefiles
sbx - spatial index for read-write shapefiles
shd - ARC/INFO shadeset symbol file
shp - Shapefile (stores feature geometry)
shx - Shapefile (stores file lookup index)
stn - geocoding standardization file
tab - lookup file
tbl - geocoding support table
tif - image file (Tag Image Format file)
tfw - world file for tif image
tmp - temporary file
ttf - TrueType font file
txt - text file (usually ASCII)
xbm - image file (X Bitmap)
wmf - image file (Windows Metafile)
wld - world file for CAD datasets
wri - Windows Write.exe file

MANAGING ERROR

By
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1. The Problems of Error, Accuracy and Precision

Managing error in GIS datasets is now recognized as a substantial problem that needs to be addressed in the design and use of such systems. Failure to control and manage error can limit severely or invalidate the results of a GIS analysis. Please see the module, Error, Accuracy, and Precision for an overview of the key issues.

2. Setting Standards for Procedures and Products

No matter what the project, standards should be set from the start. Standards should be established for both spatial and non-spatial data to be added to the dataset. Issues to be resolved include the accuracy and precision to be invoked as information is placed in the dataset, conventions for naming geographic features, criteria for classifying data, and so forth. Such standards should be set both for the procedures used to create the dataset and for the final products. Setting standards involves three steps.

2.1. Establishing Criteria that Meet the Specific Demands of a Project:

Standards are not arbitrary; they should suit the demands of accuracy, precision, and completeness determined to meet the demands of a project. The Federal and many state governments have established standards meet the needs of a wide range of mapping and GIS projects in their domain. Other users may follow these standards if they apply, but often the designer must carefully establish standards for particular projects. Picking arbitrarily high levels of precision, accuracy, and completeness simply adds time and expense. Picking standards that are too low means the project may not be able to reach its analytical goals once the database is compiled. Indeed, it is perhaps best to consider standards in the light of ultimate project goals. That is, how accurate, precise, and complete will a solution need to be? The designer can then work backward to establish standards for the collection and input of raw data. Sensitivity analysis (discussed below) applied to a prototype can also help to establish standards for a project.

2.2 Training People Involved to Meet Standards, Including Practice

The people who will be compiling and entering data must learn how to apply the standards to their work. This includes practice with the standards so that they learn to apply them as a natural part of their work. People working on the project should be given a clear idea of why the standards are being employed. If standards are enforced as a set of laws or rules without explanation, they may be resisted or subverted. If the people working on a project know why the standards have been set, they are often more willing to follow them and to suggest procedures that will improve data quality.

2.3. Testing That the Standards Are Being Employed Throughout a Project and Are Reached by the Final Products

Regular checks and tests should be employed through a project to make sure that standards are being followed. This may include the regular testing of all data added to the dataset or may involve spot checks of the materials. This allows to designer to pinpoint difficulties at an early stage and correct them.

Examples of data standards:

- USGS Geospatial Data Standards
- Information on the Spatial Data Transfer Standard
- USGS Map Accuracy Standards

3. Meta Data! Documenting Procedures and Products: Data Quality Reports

Standards for procedures and products should always be documented in writing or in the dataset itself. Data documentation should include information about how data was collected and from what sources, how it was preprocessed and geocoded, how it was entered in the dataset, and how it is classified and encoded. On larger projects, one person or a team should be assigned responsibility for data documentation. Documentation is vitally important to the value and future use of a dataset. The saying is that an undocumented dataset is a worthless dataset. By in large, this is true. Without clear documentation a dataset can not be expanded and cannot be used by other people or organizations now or in the future.

Documentation is of critical importance in large GIS projects because the dataset will almost certainly outlive the people who created it. That is, GIS for municipal, state, and AM/FM applications are usually designed to last 50-100 years. The staff who enters the data may have long retired when a question arises about the characteristics of their work. Written documentation is essential. Some projects actually place information about data quality and quality control directly in a GIS dataset as independent layers.

Examples of data quality reports:

- Data Quality Report from Texas Natural Resources Information System (TNRIS)
- Digital Line Graph Data User Guide (USGS) 1:2,000,000

In the absence of a Data Quality Report, ask questions about undocumented data before you use it.

What is the age of the data?
Where did it come from?
In what medium was it originally produced?
What is the areal coverage of the data?
To what map scale was the data digitized?
What projection, coordinate system, and datum were used in maps?
What was the density of observations used for its compilation?
How accurate are positional and attribute features?
Does the data seem logical and consistent?
Do cartographic representations look "clean?"
Is the data relevant to the project at hand?
In what format is the data kept?
How was the data checked?
Why was the data compiled?
What is the reliability of the provider?

4. Measuring and Testing Products

GIS datasets should be checked regularly against reality. For spatial data, this involves checking maps and positions in the field or, at least, against sources of high quality. A sample of positions can be resurveyed to check their accuracy and precision. The USGS employs a testing procedure to check on the quality of its digital and paper maps, as does the Ordnance Survey. Indeed, the

Ordnance Survey continues periodically to test maps and digital datasets long after they have first been compiled. If too many errors crop up, or if the mapped area has changed greatly, the work is updated and corrected.

Non-spatial attribute data should also be checked either against reality or a source of equal or greater quality. The particular tests employed will, of course, vary with the type of data used and its level of measurement. Indeed, many different tests have been developed to test the quality of interval, ordinal, and nominal data. Both parametric and nonparametric statistical tests can be employed to compare true values (those observed "on the ground") and those recorded in the dataset.

Cohen's Kappa provides just one example of the types of test employed, this one for nominal data. The following example shows how data on land cover stored in a database can be tested against reality.

See Attribute Accuracy and Calculating Cohen's Kappa.
Go to: *http://www.utexas.edu/depts/grg/gcraft/notes/manerror/manerror_f.html*
for more information.

5. Calibrating a Dataset to Ascertain How Error Influences Solutions

Solutions reached by GIS analysis should be checked or calibrated against reality. The best way to do this is check the results of a GIS analysis against the findings produced from completely independent calculations. If the two agree, then the user has some confidence that the data and modeling procedure is valid.

This process of checking and calibrating a GIS is often referred to as Sensitivity Analysis. Sensitivity analysis allows the user to test how variations in data and modeling procedure influence a GIS solution. What the user does is vary the inputs of a GIS model, or the procedure itself, to see how each change alters the solution. In this way, the user can judge quite precisely how data quality and error will influence subsequent modeling.

This is quite straight forward with interval/ratio input data. The user tests to see how an incremental change in an input variable changes the output of the system. From this, the user can derive "marginal sensitivity" to an input and establish "marginal weights" to compensate for error.

But sensitivity analysis can also be applied to nominal (categorical) and ordinal (ranked) input data. In these cases, data may be purposefully misclassified or misranked to see how such errors will change a solution.

Sensitivity analysis can also be used during system design and development to test the levels of precision and accuracy required to meet system goals. That is, users can experiment with data of differing levels of precision and accuracy to see how they perform. If a test solution is not accurate or precise enough in one pass, the levels can be refined and tested again. Such testing of accuracy and precision is very important in large GIS projects that will generated large quantities of data. In is of little use (and tremendous cost) to gather and store data to levels of accuracy and precision beyond what is needed to reach a particular modeling need.

Sensitivity can also be useful at the design stage in testing the theoretical parameters of a GIS model. It is sometimes the case that a factor, though of seemingly great theoretical importance to a solution, proves to be of little value in solving a particular problem. For example, soil type is certainly important in predicting crop yields but, if soil type varies little in a particular region, it is a waste of time entering into a dataset designed for this purpose. Users can check on such situations by selectively removing certain data layers from the modeling process. If they make no difference to the solutions, then no further data entry needs to be made.

To see how sensitivity analysis might be applied to a problem concerned with upgrading a municipal water system, go to the following section on Sensitivity Analysis.

In closing this example, it is useful to note that the results were reported in terms of ranking. No single solution was optimal in all cases. Picking a single, best solution might be misleading. Instead, the sites are simply ranked by the number of situations in which each comes out ahead.

6. Report Results in Terms of the Uncertainties of the Data

Too often GIS projects fall prey to the problem of False Precision, that is reporting results to a level of accuracy and precision unsupported by the intrinsic quality of the underlying data. Just because a system can store numeric solutions down to four, six, or eight decimal places, does not mean that all of these are significant. Common practice allows users to round down one decimal place below the level of measurement. Below one decimal place the remaining digits are meaningless.

As examples of what this means, consider:

Population figures are reported in whole numbers (5,421, 10,238, etc.) meaning that calculations can be carried down 1 decimal place (density of 21.5, mortality rate of 10.3).

If forest coverage is measured to the closest 10 meters, then calculations can be rounded to the closest 1 meter.

A second problem is False Certainty, that is reporting results with a degree of certitude unsupported by the natural variability of the underlying data. Most GIS solutions involve employing a wide range of data layers, each with its own natural dynamics and variability. Combining these

layers can exacerbate the problem of arriving at a single, precision solution. Sensitivity analysis (discussed above) helps to indicate how much variations in one data layer will affect a solution. But GIS users should carry this lesson all the way to final solutions. These solutions are likely to be reported in terms of ranges, confidence intervals, or rankings. In some cases, this involves preparing high, low,
and mid-range estimates of a solution based upon maximum, minimum, and average values of the data used in a calculation.

You will notice that the case considered above pertaining an optimal site selection problem reported it's results in terms of rankings. Each site was optimal in certain confined situations, but only a couple proved optimal in more than one situation. The results rank the number of times each site came out ahead in terms of total cost.

In situations where statistical analysis is possible, the use of confidence intervals is recommended. Confidence intervals established the probability of solution falling within a certain range (i.e. a 95% probability that a solutions falls between 100m and 150m).

7. References and Supplemental Reading

Bolstad, P.V. and P. Gessler. 1990. Positional uncertainty in manually digitized map data. International Journal of Geographical Information Systems. 4(4):399-412.

Burrough, P.A. 1990. Principles of Geographical Information Systems for Land Resource Assessment. Oxford: Clarendon Press.

Goodchild, M., and S. Gopal, eds. 1989. Accuracy of Spatial Databases. Bristol: Taylor and Francis.

King, J.L. and K.L. Kraemer. 1985. The Dynamics of Computing. New York: Columbia University Press.

Openshaw, S., M. Charlton, and S. Carver. 1991. Error Propagation: A Monte Carlo Simulation. In Handling Geography Information: Methodology and Potential Applications, ed. Ian Masser and Michael Blakemore, pp. 102-114. New York: John Wiley and Sons, Inc.

Scott, L.M. 1994. Identification of GIS Attribute Error Using Exploratory Data Analysis. The Professional Geographer. 46(3):378-386.

Be sure to check the on-line GIS bibliography at Ohio State University using the keyworks error, accuracy, precision, and managing error.

Suggested Directory Structure Guidelines

Here is a directory structure that was suggested by district technicians just starting in ArcView.

Setup up a main folder for original data and call it "Data".

Setup another main folder for newly created and/or manipulated data and call it "Work".
Follow these basic guidelines:
C:\ …\DATA\

- NRCS GIS Data Set Features
- Boundaries
- Soils
- Hydrology
- DRG
- DOQ
- WQ Data

C:\ …\WORK\

- District
- Specific Project, i.e., South Fork, Badger Pocket, etc.

- NRCS
- Temp
- Junk

Tips:

When you manipulate/change shapefiles from the existing "Data" folder, locate the changed file to the appropriate "Work" subdirectory. For example, you have just clipped the soils layer to a project boundary area. You will be creating a new soils shapefile. After naming it, locate it to the "Specific Project" subdirectory, i.e., "Badger Pocket".

Whenever you change a shapefile, ArcView will create a new shapefile. The original file will not change.

If you are using the same shapefiles in multiple projects in ArcView, i.e., field boundary layer, keep those files in the "Working" directory and subdirectory "District" or what works for you.

If you are doing a GIS project for NRCS it may be easier to keep the shapefiles in a separate folder called NRCS.

In ArcView you can have multiple projects. Try this Project name setup:

- District
- NRCS
- Specific Project, i.e., South Fork, Yakima R. Watershed, etc.
- Farm Plans

Metadata

Standards for procedures and products should always be documented in writing or in the dataset itself. Data documentation should include information about how data was collected and from what sources, how it was preprocessed and geocoded, how it was entered in the dataset, and how it is classified and encoded. On larger projects, one person or a team should be assigned responsibility for data documentation. Documentation is vitally important to the value and future use of a dataset. The saying is that an undocumented dataset is a worthless dataset. By in large, this is true. Without clear documentation a dataset can not be expanded and cannot be used by other people or organizations now or in the future.

Documentation is of critical importance in large GIS projects because the dataset will almost certainly outlive the people who created it. That is, GIS for municipal, state, and AM/FM applications are usually designed to last 50-100 years. The staff who enters the data may have long retired when a question arises about the characteristics of their work. **Written documentation is essential**. Some projects actually place information about data quality and quality control directly in a GIS dataset as independent layers.

What about data from other sources?

Before you use it…ask these questions:

What is the age of the data?
Where did it come from?
In what medium was it originally produced?
What is the real coverage of the data?
To what map scale was the data digitized?
What projection, coordinate system, and datum were used in maps?
What was the density of observations used for its compilation?
How accurate are positional and attribute features?
Does the data seem logical and consistent?
Do cartographic representations look "clean?"
Is the data relevant to the project at hand?
In what format is the data kept?
How was the data checked?
Why was the data compiled?
What is the reliability of the provider?

You can use the list above to create metadata for your data. Here is a sample of a simple text file with the necessary metadata for CDs (available in the data CD that comes with the training program) Please use this as a template for your work:

```
Metadata Report for Wa. Conservation Districts 9/00

Title: (field boundaries in Kittitas County)
Description:
     Abstract:  Kittitas County Field Boundaries are
polygons georeferenced from FSA records.
     Purpose:  for tracking crop patterns, applications,
irrigation methods; making farm plans, wq analysis

File Name: (crops.shp)
Time Period of Content: 9/23/00
Attribute Data: (Database field names - ID, fld#, Tract#,
Farm#, Acres)
Directory Path: (d:\kitcounty\crops.shp)
Dataset Format: (ArcView shapefile)
Dataset size in kB:  (3000 kb)
```

```
Source Scale:  (1:4000)
Projection:  (State Plane)
Zone:  (South Zone)
Datum: (NAD27)
Developer:  (Nicole McCoy,GIS Specialist,Kittitas County
COnservation District)
Source Date: (5/15/97)
Publication Date: (5/25/00)
Data Dictionary: (GPS only)


Updates: (keep adding onto this template when data is
changed).

Include date, description of change made, and who did it.
```

ODF State Forests GIS Tools

http://www.odf.state.or.us/StateForests/sfgis/default.htm#ODF State Forests GIS Tools

Tool	Description
10/18/2000 Version **Download**	***Xtools is an ODF-developed ArcView Extension with many tools useful in doing GIS analysis using ArcView.*** **See a description of XTools here.** **See downloading and installation instructions for XTools here.**

XTools ***Note: XTools no longer needs separate versions for data in feet and meters. See "What's New In XTools".*** What's new in XTools? **Download** XTools Project File	**For Xtools documentation, click here (document is a zipped Adobe Acrobat Reader pdf file). Download Adobe Acrobat.** **XTools FAQ (Frequently Asked Questions - Please check here before reporting a bug.)** **Reported bugs in XTools.** **Comparison of ArcInfo Overlay Functions to XTools Overlay Functions.** **Comparison of shape overlay request errors in Av3.2 to Av3.1** **ArcView 3.2 Avenue bugs that affect spatial overlay operations.** **ArcView 3.0a Avenue bugs that affect spatial overlay operations.**
Download Projector ol **11/13/97 Version** **(Click to download)**	**Projector_ol is an ODF-developed ArcView Extension that allows the projection of spatial data between the Oregon Lambert projection (the official interchange standard for Oregon State Agencies), and any other projection supported by ArcView. Note: Like the Projector Extension, Projector_ol will not accurately reproject coordinates between projections that are based on different datums. See an explanation and description here.** **See downloading and installation instructions here.**

For more information about State Forests GIS data contact:

Chris Bradberry: (503) 945-7364 chris.bradberry@state.or.us

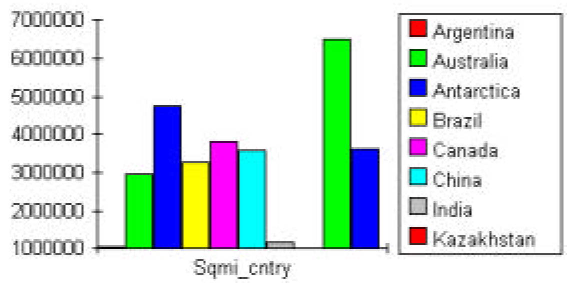
For more information about Xtools and Projector_ol contact:

Mike DeLaune: (503) 945-7352 mike.g.delaune@state.or.us

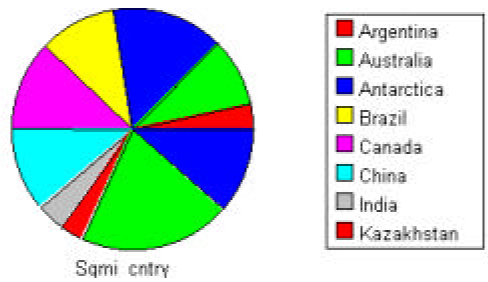
Charts Exercise

Charts display statistical information about features in Themes. They are a good way to show the relationship among parts of a whole, the rate of change, trends, or differences among groups. Charts can be in several forms, such as those shown below:

Bar Chart:



Pie Chart:



Other types of charts include: Area, Line, and X,Y Scatter Charts.

EXERCISE 2.4 Making Charts

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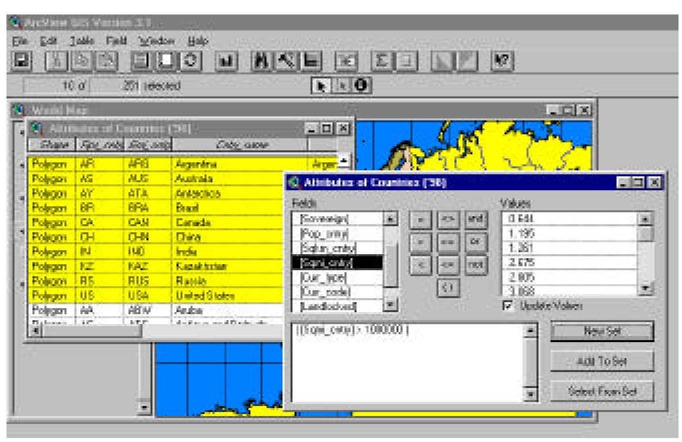
1. Query data to get data for a chart

a. Open esridata's "*world.apr*" and open "World Map".

b. Make "*Countries ('98)*" the active theme, and open its attribute table.

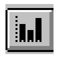
c. Build a query for countries with an area greater than 1 million square miles.

d. Promote the set.



2. Making a Chart

a. Using the promoted set in the attribute table, click the chart button on the toolbar.



b. From the *"Fields"* selection box, click on *"Sqmi_cntry"* (this will be the *'y'* value).

c. Click the *Add* button to bring it over to the 'Groups' list.

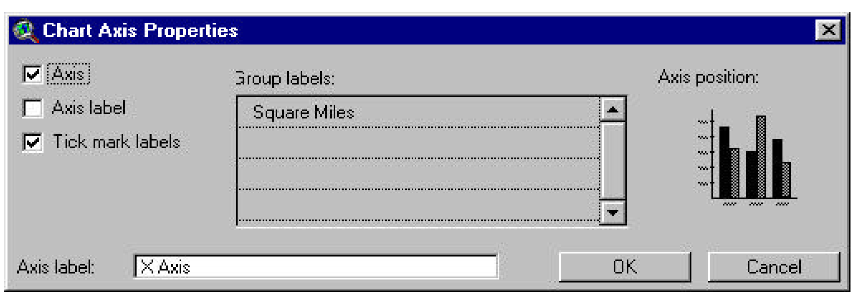
d. From the "Label series using" list, select *"Cntry_name"* (this will be the *'x'* value). (You can add comments to indicate how the chart was prepared – this is data documentation).

f. Click *OK*.

3. Change the labels of your Chart

a. Using the *Chart Element Property* Tool, click on the "Title". The Chart Title Properties dialog box opens. Enter a new title, "World's Largest Countries".

b. With the *Chart Element Property* Tool still active, click on the X axis to open *Chart Axis Properties* box and fill in as shown. Make sure the check marks on the left side of the box are checked as shown.

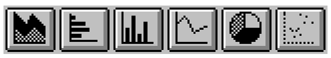


c. To change the name under the bars on the Chart, click on the Group Labels (*"Sqmi_cntry"*) on the Chart Axis Properties box and type in the name you want on your Chart ("Square Miles").

d. Click *OK*.

4. Change the type of chart (from Bar chart to Pie chart, etc.)

Choose from the symbols in the button bar:

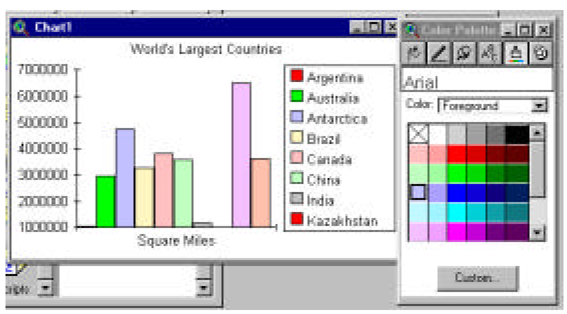


5. Change the colors of the chart (for bars or text)

a. Open the Color Palette.

b. Click on desired color.

c. Click on the text or bar (or piece of pie) to change the color. This automatically changes color to the one selected in the Color Palette.



Data Sources

NRCS - Under the GIS Training Grant Project, NRCS is providing a standard GIS data set on CD-ROM for all districts using GIS. They can only provide DOQs, DRGs, and DEMs (if available) in the projection set by the original agency, e.g. DNR, USGS. All other data can be projected to district specifications, i.e. projection, datum, units of measurement.

The following data sets are available from NRCS for all counties:

- DOT 1:24,000 scale, choice of projection (State Plane - feet or UTM - meters) streams, open water, roads, hydrography, public land survey

(PLS), township and range, county boundary, precipitation, state and county boundaries, quad boundary (needs attributes), PRISM data

- Public Lands : DNR 1:24,000

- DOQs: USGS (meters) or DNR (feet), 1meter resolution on both

- DRGs: USGS (UTM only), 1:24,000, 1:100,000, 1;250,000 scale, 7.5-minute quads

- DEM: USGS (raw data - 7.5 minute quads)

- NRCS Soil Survey (for status on survey, go to website) http://www.statlab.iastate.edu/soils/soildiv/sslists/sslisthome.html

GIS Consultants

Ascent GIS, Spokane:	1-877-927-2368
Marshall & Assoc., Olympia:	360-352-1279

Help and Resources on the Internet

The internet is a very valuable source of data, help and GIS information. The sources listed are just a start. Many of the sites have additional GIS links, which in turn have more links. Remember that URL's or web page addresses change constantly. If there are links that do not work use a reputable search engine and search with key words.

When looking for GIS data remember that there are generally three types of sources. These include:

1. Government
   - NRCS
   - USGS
   - Counties
   - Cities

2. Data Resellers
   - See the Esri Data Hound page

3. Other Users/Colleagues
   - Other Conservation Districts
   - Tribes

- Non-Profits

The links provided below are, for the most part, sources of free data. Many Counties and some of the State agencies may ask you to pay for their data.

When downloading data from the internet there are some issues to be aware of. These include:

- Lack of documentation i.e. metadata
- Media/File Size – especially grid/DEM's and images
- Many Different Formats – ArcInfo, MapInfo, Autocad, etc.
- Accuracy/Scale – Is it really accurate for your needs?
- Convenience – How much processing do you have to do? Would it be cheaper to purchase the data?
- Timeliness – Is the data to old to be useful?
- Coverage – Is the area you need covered?
- Coordinate System – Some coordinate systems can be difficult to reproject.
- Attributes – Does the data contain the information you need?
- Copyright Issues – Are there limitations as to how the data can be used?

The following are some links to potential sources of data. Most of the data on these pages are free but be aware of the data's limitations. (You get what you pay for.)

-USDA Natural Resource Conservation Service
http://www.ftw.nrcs.usda.gov/ssur_data.html
This is the official SSURGO site. All SSURGO certified soil surveys in the country can be downloaded from this site.

University of Washington libraries
http://www.lib.washington.edu/subject/WaStateMaps/dr/elnum.html

GeoDataCatalog Washington State Department of Transportation
http://www.wsdot.wa.gov/gis/geodatacatalog/
This site has a base data set for each county in the state.

Washington State Dept of Fish and Wildlife
http://www.wa.gov/wdfw/hab/release.htm/

Washington State Geospatial Clearinghouse
http://metadata.gis.washington.edu/

Washington State Department of Natural Resources
http://www.wa.gov/dnr/base/gisdata.html

Washington State Dept of Ecology
http://www.wa.gov/ecology/gis/data/data.htm

US Environmental Protection Agency
http://www.epa.gov/r10earth/datalib/

USGS EROS Home Page
http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html
Sources of DEM's, DOQ's, DLG's

http://www.reo.gov/reo/
A very good source for DRG's, DEM,s, and NRCS soils data.

Help in ArcView and on the Internet

Remember the ArcView "Help" menu has a glossary, and explanations of how to use all the functions of the program. Go here first. If you don't find your answer, there is a tremendous amount of information on the web about GIS. You can probably find an answer to the most arcane and obscure GIS question you can think of. If you are interested in arcane and obscure but many times useful information you can subscribe to a List. A very good one is: Arcview@lists.directionsmag.com. This list deals exclusively with questions about ArcView.

There is also a list you can subscribe to on the ESRI web page http://support.esri.com/. This site also has a searchable archive of previous questions that can be very helpful.

http://www.gfi-gis.de/en/services/avkb/ This site, based in Germany has a searchable ArcView Knowledge Base.

http://gis.esri.com/arcscripts/scripts.cfm ESRI scripts and extensions page
This is the first place to go if you are looking for scripts and extensions.

http://www.commenspace.org There are some useful scripts and extensions here categorized by use and linked to ESRI scripts.

http://www.geocomm.com/ GIS information and links.

www.gisportal.com/ GIS links.

www.esri.com/library Educational materials on GIS

www.usgs.gov/research/gis/title.html USGS GIS projects.

www.gislinx.com/ GIS Links.

www.utexas.edu/depts/grg/gcraft/contents.html The Geographer's Craft project. This excellent site has some very useful GIS educational materials.

www.geoplace.com Web site for publications dealing with GIS

gis.about.com General information about GIS.

www.gisdatadepot.com GIS information and links (do search for arcview scripts). You specify if you want to search their site or all other applicable sites.

References

Clarke, Keith C., Getting Started with Geographic Information Systems, University of California, Santa Barbara, 1st ed., Prentice Hall, New Jersey, 1997.

Davis, Bruce, GIS: A Visual Approach , OnWord Press, 1996, pp. 57-67.

Environmental Systems Research Institute, Inc., Getting to Know ArcView GIS, 1997.

Environmental Systems Research Institute, Inc., Using ArcView GIS, Version 3.0, 1996.

Environmental Systems Research Institute, Inc., Using ArcView GIS, Version 3.1, 1998.

Foote, Kenneth E. and Huebner, Donald J., The Geographer's Craft Project: Database Concepts, Department of Geography, University of Texas, Austin, TX, 1996.

Foote, Kenneth E. and Lynch, Margaret, The Geographer's Craft Project: Geographic Information Systems as an Integrating Technology: Context, Concepts, and Definitions, Department of Geography, University of Texas, Austin, TX.

Hutchinson, Scott and Daniel, Larry, Inside ArcView, OnWord Press, 1995, Santa Fe, NM, pp. 329.

Kaku, Clint, Kennedy Gordon, and Cihon, Ron, Introduction to ArcView Geographic Information Systems (GIS) - and WSDOT MADOG, Geographic Services Branch, Washington State Department of Transportation, Olympia, 1997.

NRCS South Central U.S. Region, GIS ArcView Training Course, GIS Core Discipline Team, Natural Resources Conservation Service, Texas 1998.

O'Connor, Sharon. Welcome to ArcView GIS Version 3.0a, GIS Technical Services Group, Washington State Department of Ecology, Olympia, 1998.

Peter H. Dana, The Geographer's Craft Project: Coordinate Systems, Department of Geography, University of Texas, Austin, TX., 1995.

Razavi, Amir H, ArcView Developer's Guide, OnWord Press, 1995, pp. 274.

Robinson, Arthur A., Morrison, Joel L., Muehrcke, Phillop C., Kimerling, A. Jon, and Guptill, Stephen C., Elements of Cartography, 6th ed., John Wiley & Sons, New York, 1995.